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GEOLOGICAL SURVEY OF CANADA
A. P. LOW, DEPUTY HEAD AND DIRECTOR.

# REPORT
ON THE
# GEOLOGY AND NATURAL RESOURCES
OF THE AREA INCLUDED IN THE
# NORTHWEST QUARTER-SHEET, NUMBER 122
OF THE
# ONTARIO AND QUEBEC SERIES
COMPRISING PORTIONS OF THE
# COUNTIES OF PONTIAC, CARLETON AND RENFREW

BY

R. W. ELLS

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1907

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To A. P. Low, Esq.

*Director, Geological Survey of Canada.*

SIR,—I beg to submit herewith a report on the Geology and Mineral resources of the area contained in the Northwest quarter-sheet map, No. 122, of the Ontario and Quebec series.

This map-sheet comprises portions of the county of Pontiac in the province of Quebec, and of Renfrew and Carleton counties in the province of Ontario. The accompanying lists of fossils are from collections made at differents periods by various members of the Geological Survey staff, which have been examined and classified by Dr. H. M. Ami.

I have the honour to be, Sir,

Your obedient servant,

R. W. ELLS.

GEOLOGICAL SURVEY OFFICE,
May, 1906.

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REPORT

ON THE

# GEOLOGY AND NATURAL RESOURCES

OF THE AREA INCLUDED IN THE

## NORTHWEST QUARTER-SHEET, No. 122, OF THE ONTARIO AND QUEBEC SERIES

COMPRISING PORTIONS OF THE COUNTY OF PONTIAC, QUEBEC, AND OF
CARLETON AND RENFREW COUNTIES, ONTARIO,

BY R. W. ELLS.

## INTRODUCTION.

The official number of the map-sheet to which this report relates is No. 122, known as the "Pembroke sheet." It lies west of and joins map-sheet No. 121, or the "Grenville sheet," and has an area of 3,456 square miles. The eastern limit of the sheet is not far from the Gatineau river, north from Ottawa city, and the southwestern portion is traversed by the Ottawa river from a point about thirty miles west of Pembroke to within ten miles of the city of Hull.

### POSITION OF STREAMS.

The area north of the Ottawa is intersected by several large streams. In addition to the Gatineau, which crosses near the eastern margin of the map, from the northern limit of the townships of Northfield and Wright, there are several large branches of this stream from the west. The principal of these is the Pickanock which rises in large lakes, among which Dumont and Squaw lakes, in the unsurveyed area north of the townships of Huddersfield and Clapham, are the most important. The stream joins the Gatineau in the central part of Wright township nearly sixty miles north of the city of Ottawa. Farther south other important tributaries are the Kazabazua, Stag creek and the Pêche river, the last entering the Gatineau near the village of Wakefield.

In the western portion of the area included in the map are the Coulonge and Black rivers, both large streams from the north. The former enters the Ottawa at the village of Fort Coulonge in the township of Mansfield, about three miles above the head of Calumet island, while the latter flows into the north or Culbute channel of the Ottawa, near the lower end of Allumette island, in the township of Waltham, about nine miles west of the mouth of the Coulonge.

The area on the south side of the Ottawa is also intersected by several important streams. Of these one of the largest is the Petawawa which rises near the headwaters of the Muskoka river and flows northeast until it meets the Ottawa about nine miles west of the town of Pembroke. For a large part of its course this river has the reputation of being rough and difficult to traverse with canoes. It was, however, surveyed in 1853 by Mr. Alexander Murray of the Geological Survey, who reports that the country thus traversed is largely granitic in character throughout the greater part of its course.

Among other streams which flow into the Ottawa from the south, and are included in the area of the map-sheet, are the Indian and the Musquash rivers, which come in at the town of Pembroke, and the Bonnechére, a large river which joins the Ottawa at a point on Chats lake about twelve miles west of the town of Arnprior. The Madawaska, also an important stream which enters the Ottawa at the latter place, lies to the south of the present map-sheet.

The area north of the Ottawa, with the exception of a belt of townships in the more immediate vicinity of the Gatineau and those adjacent to the Ottawa itself east of the Black river, is almost entirely unopened for settlement. West of the Black River roads extend along the north side of the Ottawa to the deep bay at the lower end of what is known as the Deep river opposite High View, which is at the sharp bend about twenty miles above the town of Pembroke. Roads also extend north nearly to the rear of the township of Sheen, but a large portion of this area is still unopened. Between the Black and Coulonge rivers several settlement roads have been made for a distance of eight to ten miles, and portage roads continue along these streams for some miles farther. In all these townships the travelled roads are in close proximity to the Ottawa. Beyond these the country is generally rough and practically inaccessible outside of the canoe routes along the rivers mentioned.

East of the Coulonge the country is fairly well opened up as far north as the head of Otter lake on the Pickanock rivér whence a umber or portage road extends northwest to Squaw lake and thence to the upper part of the Coulonge river.

South of the Ottawa the area between the river and the Bonnechère is much less broken, and good settlements are common. There are here large outcrops of the limestones of the several Palaeozoic formations, the decay of which usually produces a soil very favourable to agriculture, and the crystalline limestones also have a comparatively widespread development as compared with the country north of the Ottawa.

This portion of the map-sheet is also traversed by several lines of railway, among which are the Canadian Pacific from Ottawa westward, the Grand Trunk, and the Pembroke Southern which extends from the town of Pembroke to meet the Grand Trunk at Golden lake. On the north side of the Ottawa the only railway yet constructed, in addition to the line up the Gatineau river, is the Waltham branch of the C. P. R. system, which now terminates near the mouth of the Black river. The Maniwaki branch of the C.P.R. system extends northward, keeping for a considerable part of its course in close proximity to the Gatineau river. This road for some years ended at the village of Gracefield, about one mile above the mouth of the Pickanock, but is now completed to Maniwaki, at the mouth of the Desert river.

The area included in map-sheet No. 122 presents somewhat different geological features from those found in the adjoining map-sheet to the east. In the part near the Gatineau river there is a much greater development of the crystalline limestones belonging to the Grenville or Hastings series than in the western half of the area. This area of calcareous rocks, while greatly interrupted by masses of granite and occasional outcrops of the grey gneiss, has a breadth from east to west of nearly fifteen miles, and extends northward far beyond the limit of the map-sheet. Its distribution in this direction along the Gatineau river and its tributaries has already been briefly described in the report on map-sheet No. 121.

Westward of the calcareous rocks, the formation is largely granitic in character. These granites are often well foliated, though this feature is also frequently absent. Along the Coulonge river as far north as our examinations along this stream extended, or to a point about seventy miles from its junction with the Ottawa, measured along the stream, large areas of greyish and reddish-grey gneiss are seen. They are associated with beds of crystalline limestone and quartzite, resembling in this respect the characteristic rocks of the Grenville series. Large portions of this district are covered by heavy beds of sand. The limestone and quartzite are rarely seen west of the mouth of the Black river.

South of the Ottawa large outcrops or outliers of Palaeozoic rocks, principally Black River limestone, occur, while the western part of this area, especially in the townships of Alice, Fraser, Petawawa and Buchanan, is occupied to a large extent by heavy deposits of clay and sand.

In connexion with the crystalline limestone and associated gneiss found in the district south of the Ottawa there are large areas of crystalline schist. Rusty and yellowish weathering dolomite, often with irregular bunches of quartz, is also a marked feature in the rocks of this district. The schists and dolomite have a wide development along the line of the Kingston and Pembroke railway, being the northern prolongation of large masses of these rocks which are found in the counties of Frontenac and Hastings.

The earliest work on the geology of the district dates back to 1852-53, and was done by Mr. Alexander Murray, the then Assistant Director of the Geological Survey. In the latter year Mr. Murray made a number of traverses and surveys of important rivers in the country south of the Ottawa, comprising the Petawawa from its source near the headwaters of the Madawaska and Muskoka to the junction with the Ottawa above Pembroke; and the Bonnechére from the Ottawa to Round lake which is a few miles west of Golden lake on the Grand Trunk railway. From Round lake a traverse was made across country to the Madawaska River waters, which were reached at what is now known as Barry bay. The geological features of the country adjacent to these rivers were carefully mapped at that time.

In 1853 Mr. James Richardson made a series of surveys in the Pembroke district, including Allumette island, and continued his work east by tracing the road from Pembroke to Ottawa city. Later, in 1876, Mr. L. R. Ord, working with Mr. H. G. Vennor, carried on the work in this area, surveying the greater part of the roads to the north of the Ottawa between Coulonge river and the Gatineau, and on the south side over portions of Westmeath, Ross and Horton townships.

In his report for 1876 Mr. Vennor describes the leading geological features along the Ottawa from the town of Arnprior as far west as the junction with the Mattawa river. The distribution of the crystalline limestone in the eastern portion of the county of Renfrew is also given, and the connexion of these with similar limestones north of the Ottawa is clearly stated, the two being regarded as equivalent formations. In this way the rocks which had been described in the earlier reports under the name of the "Grenville series" were shown to belong the same horizon as those which in the area south of the Ottawa had been styled by Vennor the "Hastings series." The statement thus put forward by Vennor, nearly thirty years ago, has been to a large extent supported by the detailed work in the district, as well as to the east and west, during the last ten years. A large amount of attention was also given by Mr. Vennor to the study of the economic minerals of the area, more especially to the deposits of iron, mica, graphite and apatite.

The relations of the several divisions of the crystalline rocks in eastern Ontario will be found discussed fully in the preceding report on the Perth sheet.

The different rock formations found in the area comprised in map-sheet No. 122 are as follows :—

*Palaeozoic formations.*

Trenton limestone.
Black River limestone.
Chazy limestone and shales.
Calciferous dolomite.
Potsdam sandstone.

*Crystalline rocks, including :—*

Granite and granite-gneiss.
Gneiss, quartzite and limestone of the Grenville series.
Anorthosite and other igneous rocks.
Post-Pliocene deposits.

Owing to the fact that the crystalline rocks are the more important geological feature in the area under consideration, their description will be first given.

## THE CRYSTALLINE ROCKS.

In general character the crystalline rocks of the area north of the Ottawa and west of the Gatineau river closely resemble those already described in the preceding report for the country east of that river. The lowest member is a reddish and reddish-grey granite-gneiss which is generally foliated but in places lacks this feature, the rock becoming massive. It is like much of that found in the larger areas which separate the principal bands of limestone in the Grenville district; and while in places these granitic rocks cut the limestones and associated gneiss of the Grenville series, over other large areas they appear to underlie these rocks.

Above these granite-gneisses are the usual reddish-grey and grey gneisses which are frequently garnetiferous. They also in places contain apparently interstratified bands of amphibolite, and in their upper portion have at times a considerable thickness of white quartzite which generally underlies the crystalline limestone.

The main area of the limestone west of the Gatineau river terminates about ten to twelve miles from that stream. Beyond this, westward, the rocks are largely of the gneissic variety, in places granitic, but the limestone is rarely seen except in thin bands. The most westerly point at which the calcareous member of the series was observed along the Ottawa is about two miles beyond the mouth of Black river. Beyond this to the western limit of the map-sheet the limestone was not recognized except at one point on the north side of that part of the Ottawa known as the Deep river between High View and Des Joachims, where a small and irregular band seems to have been caught in a mass of intrusive granite and much distorted. Portions of this granite in the western area seem to be of undoubtedly later date than the limestone and associated gneiss. This feature is well seen along the Ottawa near the village of Portage du Fort, at Bryson, and at several places on the eastern portion of Calumet island. Here the limestone bands are often abruptly cut off, sometimes by granite and occasionally by anorthosite rocks, while there are also large masses of a dark diorite. The granitic mass occupies a large part of the townships of Clarendon, Litchfield, Leslie and Thorne, and continues in a broad belt northward to the Desert river, where its occurrence has already been mentioned in the preceding report (1898).

A traverse was made of the Black and Coulonge rivers from their junction with the Ottawa northward for about seventy miles. On both these streams the gneiss and crystalline limestone of the Grenville series were recognized. On the Black river the limestone was observed at intervals as far north as thirty miles from the mouth, especially along a chain of lakes in the township of Bryson, known as the Green Lake portage route, by which a rough portion of the river is passed. The general strike of the rocks here is to the northwest, following generally the course of the stream. The upper portion of the Black river is occupied, as far as our traverse extended, by the granitic portion of the series.

Along the Coulonge the gneiss of the Grenville series is associated with quartzite and limestone. The gneiss is sometimes very well bedded, and in the cliffs on some of the lakes, notably on Bryson lake, the outcrops closely resemble well-bedded masses of Potsdam sandstone. In this respect the rocks are very similar to certain of the gneisses seen on the upper part of the North Nation river in the Grenville district.

Along the north side of the Deep river (Ottawa), certain portions of the gneiss formation are well banded and the dip is at a high angle, sometimes to the east, but in places to the west, indicating an anticlinal structure. The same features are seen in the rocks where exposed along the south side of the river, though the exposures are here less frequently seen owing to sand deposits which prevail over much of the area in this direction. In places, however, especially towards the Rapides des Joachims, the rocks are more massive.

In the area between the limestones of the Gatineau River belt and the outcrops of the similar rocks along the Coulonge river there appears to be a marked divergence in the strike of the gneiss, which extends for a considerable distance. Thus in the former district the strike of the gneiss and associated limestone varies from N. 50° E. to N. 10° E., while along the latter stream the general strike is from twenty to thirty degrees west of north. The cause of this divergence seems to be the presence of a large area of granite and granite-gneiss which is extensively developed in the country east of the Coulonge and which extends across to the upper part of the Pickanock waters. The peculiar action of certain portions of this mass is seen in the abrupt termination of some of the limestone bands as well as the associated gneiss at a number of points. This divergence in the strike of the gneiss and limestone through the agency of granite masses is also well seen at other points in the area of the Grenville sheet, as also in that to the south.

## COULONGE RIVER.

The Coulonge river has a length of about 150 miles. It enters the Ottawa near the village of Fort Coulonge, in the township of Mansfield, about three miles west of the head of Calumet island. The current is often swift and in many places broken by heavy rapids and falls which render its ascent difficult for canoes. The upward journey is generally accomplished by taking advantage of a chain of lakes along the west side which extend north for about thirty miles, or, by making several portages and continuing the route through Bryson lake and creek, the main stream can be reached at about seventy-two miles from the mouth, or one and a half miles north of the junction of Crow river, a tributary from the east. Above this point on the Coulonge the ascent of the river is much more easily accomplished.

Along that part of the stream for half a mile on either side of the Crow river grey gneiss, associated with bands of crystalline limestone, is the prevailing rock. The gneiss is sometimes rusty and in places associated with black bands, probably an amphibolite, having a strike of N. 20° W. and dipping N. 70° E. 15°-20°. The limestones appear at several points below, notably at the small bend about two miles above the first fall, which is between the sixty-four and sixty-five mile posts.

This fall is about seven feet high, over dark hornblendic, with reddish and grey, gneiss, the strike and dip of which are the same as just recorded, and this appears to be the general strike of all the rocks throughout this part of the country. The portage past the fall is a fourth of a mile in length, on the west bank of the river, and the gneiss and limestone are here abruptly cut off by a mass of red granite. A conglomerate band is seen in the limestone a short distance above the falls, the pebbles consisting of red and grey gneiss, well rounded and stuck in the limestone at all angles. The resemblance of these pebbles to the rocks of the Grenville series, as also to those of the Hastings series as seen along the Mississippi river, is very marked.

At this fall a steep granite mountain rises to the west of the stream, but below this as far as Devil chute, almost twelve miles farther down the river, the shores are generally low and for the most part consist of sand and gravel. Occasional outcrops of the usual gneiss appear with a dip of N. 80° E. $< 60°$-80°. The same dip is seen at the Chute in greyish and black gneiss which is cut by granite dikes. Small bands of limestone with inclusions of rusty gneiss are found at many of the gneiss outcrops. In places the limestone is quite dolomitic and weathers a buff-yellow. High ridges of granite-gneiss occur along the east bank of the river, between the main stream of the Coulonge and the east branch.

Below this for some miles the course of the river is much more crooked. The exposed rocks are usually of the gneissic variety, for the most part of a reddish colour, but with associated black and grey bands, and occasionally a band of buff-weathering dolomite is seen. At what is known as the Post-office rapid, a short distance below the forty-eight mile post, the dip changes to southwest < 20°, and on a trail thence to Murtagh depot, which is about one mile and a half east of this place, a ridge of the granite gneiss is crossed. The country in this direction appears to be much more broken, and high ridges are numerous. Small patches of a pinkish limestone, generally much contorted, are found with the granitic rocks of this part of the river.

Thence down stream the shores are lower, with sandy or gravelly banks and occasional ridges of high land. At Duval creek, near the forty-four and a half mile post, there are high hills on the southwest of a coarse reddish granite, but a short distance above this point the usual reddish-grey and black gneiss dips N. 70° E. < 10°.

From this place to Ragged chute, which is at the thirty-six mile post, the shores are sandy and no ledges are seen, though hills rise a short distance back from the stream. This chute is over a mass of red granite which is intruded through the gneiss, and the place is very rough, with bold cliffs of red granite and gneiss on the east bank and low ledges of the same on the west side. No foliation could be determined in the rocks at this place. The falls are ten or twelve feet in height and the portage comes down over a wing dam and along an island in the stream. The granite forms heavy rapids in the river below, and there is a dike of diabase six inches wide which cuts the granite and gneiss.

At Gelinas chute, which is at the thirty-four mile mark, the gneiss is much broken up by intrusives, but a little below this place it assumes a strike of N. 30° E. and dips S. 60° E < 10°.

Below this again to the forks of the East branch the shores are low and gravelly, and no ledges show along the stream. The ascent of the East branch was not practicable at the time of our visit, owing to the low stage of the water. It is described as a very rough stream with many falls and portages, and the rocks are probably largely of the granitic or granite-gneiss varieties.

Below the Forks the shores for several miles are largely composed of sand and gravel. Occasional ledges of grey and black gneiss are seen, and at the Poplar rapids these gneisses contain a small band of yellow-weathering dolomite. The strike here is N. 30° E. and the dip S. 60° E. < 10°. At the Bear chute, near the twenty-six mile mark, the strike of the grey and black gneiss is N. 20° W. and the dip N. 70° E. < 20°. Below this for several miles similar rocks are seen at intervals.

The river from the twenty-six to twenty-three mile marks is very rough, making navigation with canoes treacherous. Steep mountains rise on both sides and there are several portages.

The Island rapids are caused by heavy masses of coarse granite which cut the gneiss, and along the portion of the stream between the twenty-five and twenty-three miles posts, large blocks of green pyroxene are seen along the shore.

Between this and Bryson creek, which comes in from the west near the seventeen mile mark, are several rapids, the current being very strong and in places rough. Among the rapids are the Island, Horse-shoe, Trois Roches and Long. The rocks along this stretch of the river are mostly reddish-grey and grey gneiss with small bands of limestone, all of which are cut by masses of red granite. Similar gneiss and limestone bands continue down to the Grand falls, which are about four miles above the village of Fort Coulonge, but in the last four miles before reaching the falls the shores are low and composed of sand and gravel, rock outcrops being very rarely seen.

The Grand falls are sixty feet in height, over masses of limestone and granite, but below this to the junction with the Ottawa the river flows through sand plains, underlaid by clay of the usual bluish-grey variety.

## BLACK RIVER.

The Black river was ascended for about seventy miles, whence a route was followed across to the Coulonge by way of Foran creek and lake, and Lynch, Travers and Bryson lakes and the upper Bryson creek. None of these lakes except the last are indicated on any map in our possession, and in the absence of any guide who knew the proper portages some difficulty was at first encountered in finding our way across. The portages are usually short and easy, except the last to Bryson lake which is two miles long over a rather steep ridge.

The country along the lower ten or twelve miles of the Black river, between this stream and the Coulonge, is traversed by several roads, which meet at what is known as the Culbute, a fall and rapid about ten and a half miles from the mouth of the river, which joins the back or Culbute channel of the Ottawa near the lower end of Allumette island.

At about one mile and a half from the mouth of the river there is a fall said to have a height of 100 feet, past which a timber slide is built. At the Culbute the amount of the fall is but little over three feet but there is also a heavy rapid. Above this for several miles the river is very rough, and a portage road over a mountain spur composed of quartzite, gneiss and thin bands of limestone, strikes the river again at the upper end of the big bend, between the thirteen and fourteen mile marks. Above this point the road keeps along a narrow flat close to the river as far as the mouth of Green creek, and exposures of limestone with gneiss are seen for some distance in the cliff along the east side of the river. The road is made along the base of this cliff.

Above the mouth of Green creek, which enters the Black river at the seventeen mile post, the river for thirteen miles is very rough and many rapids occur. This part of the stream is usually passed by a portage route through a chain of lakes, with short connecting portages, the last or more northerly being three-fourths of a mile in length. This reaches the river again near the thirty mile post or about half a mile below the Manitou rapid.

The strike of the gneiss and limestone along the east side of the road in the cliff below Green creek is about N. 20° W., the dip N. 70° E. $<$ 20°-30°. Much of the associated gneiss is highly quartzose, and the rocks all belong to the Grenville series. At the mouth of Green creek the limestone occurs in a heavy band having a similar strike and dip, and this band keeps on up the creek and across Green lake, apparently in a syncline, since rusty gneiss shows along both shores of the lake. Pyroxene is here associated with the gneiss and limestone.

There are five lakes along the portage route past this part of the Black river. On all these the rocks are similar in character and the band of limestone is apparently continuous throughout. A reverse dip to the southwest is seen in the gneiss about midway on the route showing an anticline in this portion of the series.

On the main river above the Manitou rapid the shores are generally low and the banks are of sand and gravel. There is a very uniform current in the river of about two miles per hour at ordinary stage of the water, and many bends occur, the river winding through the sandy flats in a very tortuous course. At the thirty-three mile mark reddish-grey and dark gneiss appears, with a northwest strike, the dip being N. E. $<$ 20°. Then low sand banks extend for nearly ten miles to red granite ledges which come to the river from the south.

Small ledges of gneiss also show at forty-four miles, and there is a large cliff of red granite on the west side above the forty-five mile mark.

Above this for a couple of miles granite and gneiss hills rise on the east of the stream. At fifty miles there is a rapid, the water flowing over rusty quartzose gneiss which has a southwest dip < 10°, and at the Bear rapid, one mile above, banded gneiss is cut by granite dikes, the dip of the former being west < 15°. The banks of the river all along are composed largely of sand.

About one mile above Bear rapids is the foot of the Mountain portage. This is three miles in length, past a very rough portion of the river with a heavy chute at the upper end. The rocks are all gneiss and granite with a dip to the west < 20° 30°. Thence up to the fifty-eight mile post the river is broken by chutes and heavy rapids, and the ascent is difficult: the rocks are exposed at frequent intervals and consist of gneiss with some granite throughout. Greyish mica-gneiss, cut by granite, is seen at sixty-two miles with a dip to the S.W. < 12°, and thence up to Foran creek, where the portage route to the Coulonge takes off to the east: the banks are for the most part of sand, and the country is low or broken by scattered ridges of gneiss and granite.

The upper part of the Black river was not examined. It apparently flows for a good part of its course through sandy country, and the Crown Lands survey of the stream shows no falls and but few rapids.

No limestone was seen along the route traversed between the Black and Coulonge rivers, though bands of this rock may occur along the shores of some of these lakes. The rocks observed were all gneisses of the Grenville series, well-banded and showing the presence of several anticlines between the two rivers.

Along the shores of Bryson lake the principal rock outcrops are of greyish quartzose and sometimes black gneiss, generally well banded. This lake is twelve to fourteen miles in length from south to north, with several long bays and numerous islands scattered throughout. It discharges by a creek about three miles in length from a bay at the northeast end, into the Coulonge river, as already noted in the remarks on that stream.

## OTTAWA RIVER.

The Ottawa river, which traverses the area of the map-sheet diagonally across the southern half, presents some interesting features both from the physical and geological standpoint. The valley of the river is of great antiquity, and was undoubtedly excavated before the time of the Potsdam sandstone, since this, the oldest of the Palaeozoic formations in the district, was deposited upon the eroded Archaean floor.

The present channel of the river presents a series of somewhat narrow lake expansions which extend from the city of Ottawa to the Des Joachim rapids, a distance of about 150 miles along the stream. The first of these in ascending order is Lake Deschenes which extends from Britannia to the foot of the Chats falls. The elevation of this lake or expansion of the Ottawa, taking the low water readings for Mr. J. White's book on "Altitudes in Canada", is 189 feet above the sea. This part of the river is navigable for steamers throughout its entire length to Fitzroy harbour which is just below the falls.

The waters of this river expansion are separated from those of the next above, which is known as the Chats lake, by the Chats falls and rapids. The elevation in the river caused by this obstruction to navigation is about fifty feet. Chats lake with an elevation of 239 feet (low water level) extends to the Chenaux rapid, where the ascent is broken by a slight fall of only a few inches at low water. This can be readily ascended by steamers, and the navigation is thus continuous from the foot of Chats lake a short distance below Arnprior to Portage du Fort village.

At this place the upward navigation is broken for some miles by a series of heavy rapids and falls. The river is divided into two channels, a short distance above this village, which flow on either side of Calumet island. That on the south side is known as the Roche Fendu channel, and that on the north as the Calumet channel. The former is very rough for the greater part of its course, there being a total rise of 100 feet from the foot of the Portage du Fort rapids to the head of La Passe rapid, a distance of twenty-six and a half miles.

On the Calumet channel the broken water space is much shorter, terminating at the village of Bryson where steamboat navigation is again resumed. This place is about eight miles north of Portage du Fort by road, the rise in the river in this interval being about ninety-six feet. The Calumet channel, which flows past the north side of the is'and, is largely cut out of sands, so that the navigable channel is liable to change every year during the period of high water in the spring.

The elevation of Lake Coulonge, which is the usual name of the lake expansion between the head of Calumet island and the foot of Allumette island, which is about eleven miles farther west, is placed at 341½ feet above sea-level, and of the channel at the foot of Allumette island as 344.2 feet.

The two channels which flow past this island are known as the Culbute on the north side, and the Pembroke around the south and east sides. The former is quite straight and is broken by two rapids and a fall. The first rapid is at the village of Chapeau and is about a foot in height, but the l'Islet rapid and Culbute fall, which are now overcome by means of a lock, have a rise of seventeen feet and the elevation of Pembroke or Allumette lake is given as 363.5 feet above the sea.

The south or Pembroke channel is broken by two rapids, the lower known as Paquette near the lower end of the island, and the upper or Allumette rapid about three miles below the town of Pembroke. Steamboats run from the village of Bryson to the foot of Paquette rapids, and formerly by passing the lock in the north channel could enter the Allumette lake and thus continue to the foot of des Joachims rapid, at the head of what is known as the Deep river or the portion of the Ottawa lying between High View and the rapids just mentioned. The altitude of the Deep river is given as 364.8 feet.

The course of the Ottawa, being for the greater part almost at right angles to the strike of the rocks throughout this area, affords a very fair section across the southern portion of the map-sheet. Along the part between Ottawa city and the Chats falls the Palaeozoic formations including the Potsdam, Calciferous and Chazy are well exposed, especially along the south or Ontario side. On the north side the Chazy and Calciferous extend westward as far as the mouth of Breckenridge creek when the granite and gneiss come to the shore and continue up river to within about one mile of Quio village. Here dolomites of Calciferous age again appear resting on the eroded surfaces of the granitic rocks and capped by the greenish-grey shales and sandstones of Chazy age in the village itself. To the north, on the bank of the Quio river in rear of the village, Potsdam sandstone occurs, and it is possible that a fault crosses this area by which the extent of the Calciferous is much reduced. The dolomites are again seen at the foot of the Chats falls on the north side of the river at the village of Old Pontiac in a very limited outcrop, but the Potsdam sandstone does not occur at this place.

Passing the Chats falls and rapids, which are caused by a barrier of crystalline limestone much intersected by granite dikes, outcrops of gneiss, schists of various kinds, diorites and red granite again appear along the north shore. At the road leading down to the ferry which crosses to Braeside from Bristol iron mines the Calciferous dolomite occurs in irregular patches upon the crystalline rocks and forms a narrow margin along the shore as far west as the point near Norway bay, above which another point below Bristol wharf is formed of granite and gneiss with some limestone. The crystalline limestone is seen at frequent intervals as far west as Portage du Fort village, interstratified in places with bands of greyish gneiss, and occasional masses of granite and anorthosite. Large portions along the north side are occupied by heavy deposits of reddish sands; which are extensively developed in the townships of Bristol and Clarendon, situated to the north of this part of the Ottawa; and occasional masses of red granite are seen, with small bands of crystalline limestone. In the northern portion of Clarendon township there is a large area of granite, in places without foliation, which rises to the east of the Ottawa a short distance below the village of Bryson, and extends northerly into the townships of Thorne and Leslie. The breadth of this large mass is about ten miles from east to west.

Along that part of the Ottawa between Portage du Fort and Bryson the rocks are for the most part calcareous. The limestone in places forms a marble of excellent quality, which has been quarried, and some of the decorative pillars for the Parliament buildings in Ottawa were taken from the rock near the former village. A new quarry has been opened within the last half-dozen years near the Bryson road, about one mile and a half north of the Portage village. Small patches of Calciferous dolomite also occur along this road which turns off to the eastward about two miles north of the village the rock resting upon the eroded surface of the crystalline limestone.

## CALUMET ISLAND.

The part of the Ottawa river between this village and Bryson is very rough and broken by numerous heavy rapids and falls. These are caused by dikes and masses of granite which have broken through the limestone and twisted the latter in every direction. Masses of green stone or diorite also occur, and in places the rock is serpentinized and small veins of chrysotile occur. This feature is well seen at the Grand Calumet falls about half a mile below Bryson village, and also in a cliff of limestone at the west end of the bridge over the Ottawa leading across to Calumet island.

The east end of this island is occupied largely by granite and diorite. Along that portion bordering on the Ottawa river and extending from the shores of the Roche Fendu lake to Bryson an irregular band of crystalline limestone occurs which is much broken across and injected with granite dikes, some of which are of large size. The granite mass extends across the Roche Fendu channel into Westmeath township, and westward on the island to about the line between lot one, range VII, and lot 22, range III, where ledges of limestone and grey gneiss again appear. The eastern end of the island, in addition to the granite, also shows large masses of diorite or gneiss in which large pockety masses of galena and zinc blende occur, which have been worked at irregular intervals for some years. The west half of the island consists in large part of plains of sand, with a small growth of pine, and the rocks where exposed are greyish gneiss with occasional thin bands of limestone. On the southwestern extremity greenish Chazy shales occur, underlaid by the Calciferous dolomite. This is in the area opposite the point known as La Passe on the Ontario side of the river. The dolomite and overlying shales rest upon the gneiss and granite of the west end of the island. They form the lowest beds of the Palaeozoic basin in this direction, the rocks of which occupy nearly the entire surface of Allumette island to the west, as well as large portions of the townships of Pembroke, Stafford and Westmeath on the south side of the Ottawa.

The channel around the north side of Calumet island is cut through sand for the greater part of the distance from La Passe to Bryson. Hills of granite rise on the south side of the channel opposite Campbell bay, while along the north side of the river in the township of Litchfield similar granitic rocks are a conspicuous feature. These granites are generally foliated, and in places there are areas of the Grenville gneiss and limestone. This granite-gneiss belt extends across to the headwaters of the Pickanock and is well displayed to the west of Otter lake in the townships of Huddersfield and Clapham, and around the shores of Lake Dumont still farther north.

Between the head of Calumet and the foot of Allumette islands the shores are generally low and are composed largely of sand and clay. Above the mouth of the Coulonge river, at Pointe Seche, on the north side of the Ottawa, flat-lying ledges of Black River limestone are exposed, from which the characteristic fossils of this formation have been obtained. Crossing a rather deep bay on the north side of the river, above this point, ledges of Trenton limestone appear on the west side underlaid by limestones of Black River age. These in turn rest upon the eastern flank of a hill of gneiss and limestone, much broken up and intersected by masses of red granite.

The lowest beds of the Black River formation at this place are dolomitic and were at first supposed to belong to the Calciferous formation but the finding of masses of *Columnaria halli* and of *Tetradium fibratum*, with other characteristic forms, has enabled us to determine their exact position. The basal beds are inclined against the crystalline rocks at an angle of nearly fifty degrees and are somewhat altered. The locality is a few hundred yards east of the place called The Boom.

Thence up the river to the foot of Allumette island the banks are generally low and sandy and ledges are not seen. Along the south shore, however, pieces of the Black River limestone are common, and there are low ridges largely made up of these rocks, so that it is probable that the formation extends in this direction over a considerable part of Westmeath township. On the north side of the Ottawa, gneiss and granite, with occasional thin bands of crystalline limestone, are seen a short distance inland, protruding through the sand drift, where they form the southern edge of the great Archaean mass.

At Paquette rapids, which is at the lower part of the Pembroke channel near the lower end of Allumette island, large ledges of Black River limestone cross the stream. These abound in well-preserved fossils of which large and characteristic collections have been made by several officers of the Geological Survey. The Black River formation would appear to occupy a considerable part of the eastern half of this island, overlying the Chazy limestones which are well exposed along the shore near the Allumette rapids, about three miles below the town of Pembroke, and which there rest upon greenish-grey sandy shales which represent the lower portion of the Chazy formation. These shales are also well developed on the south side of the river in the vicinity of and to the rear of the town of Pembroke. They also occupy several of the large islands in the channel from three to four miles below this place.

## ALLUMETTE ISLAND.

Allumette island, while largely occupied by sands and clay, especially along the north side and east end, shows at several places outcrops of the Palaeozoic rocks. On the extreme northwest corner above the Culbute lock ledges of granite-gneiss are exposed along the shore, as also at the bridge near the village of Chapeau. These old rocks resemble the fundamental gneiss of the Laurentian. They are overlaid near the northwest corner of the island by Calciferous dolomite, which occupies the west end and extends along the shore southward for about three miles in the direction of Pembroke, where it is in turn overlaid by the Chazy shales. The dolomite has a low dip of three degrees to the south, and similar rocks occur on the south side of the Ottawa at intervals nearly to the west line of Pembroke township, forming a narrow margin along the shore. The Potsdam sandstone was not seen in this direction.

The Chazy shales which overlie the Calciferous continue along the south side of the island for some miles, and are occasionally exposed along the beach, the beds being nearly horizontal. They pass up into the Chazy limestone near the head of Allumette rapids, the latter being well seen in a quarry on the island near the foot. The exact limit of the several formations is hard to determine owing to the paucity of exposures, much of the interior part of the island being sand covered.

### OTTAWA RIVER—*Continued.*

The sands continue westward along the course of the Ottawa river past the village of Fort William, and extend northward over the southern part of the townships of Waltham, Chichester and Sheen until they meet the bold ridge of crystalline rocks which formed the ancient limit of the river channel in pre-glacial times. Over this intervening space the sands and gravels frequently occur in ridges, and rock outcrops are rarely seen. Above Fort William the course of the river changes to an almost north and south direction for several miles to the foot of the stretch known as the Deep river, which name is given to the Ottawa for that portion between High View and the Rapide des Joachims, a distance of nearly thirty miles, the water in portions of this stretch being reported as quite 500 feet in depth.

The rocks along that portion of the river from the Culbute falls and lock in the north channel, to MacKay point opposite High View on the lower end of the Deep river, where exposed are all granite gneiss. Banding is rarely seen, and even foliation is frequently absent, the rock having the aspect of a massive granite.

In the area north of the Deep river the first prominent feature is what is known as Oiseau rock. This is a bold headland of reddish-grey gneiss and granite, in places well foliated, rising to a height of 500 and in places probably 800 feet above the river. A short distance above the rock the foliation has a strike of N. 15° E. the dip being to the east 30°. The rocks, however, lack the banded aspect of the gneisses of the Grenville series.

The granitic rocks extend in a bold ridge to the Narrows, about seven miles farther west, where they form bold cliffs. At this place there is a band of dark dioritic rock, about fifty feet wide, containing pebble-like masses of similar looking rock.

Above this to the mouth of the Shehyn river the shores become gradually lower with intervals of sand, but ridges of granite-gneiss rise a short distance inland. The rock has the same generally reddish colour and is in places foliated. To the north along the whole stretch of the Deep river the country is reported as very rough with great hills and abrupt cliffs, and almost impassable except in winter.

At the entrance to the shallow bay, about one mile east of Shehyn river, a thin irregular band of crystalline limestone, with a little grey gneiss, occurs along with the granite-gneiss. This limestone is much twisted and appears as if caught in a mass of intrusive granite and crushed out of its regular stratified character.

While the dip of the foliated gneiss at the Oiseau rock is to the east, above the Narrows it inclines to the northwest, indicating an anticline, and occasionally the strata appear to be nearly horizontal. In most cases, however, the banding as well as the foliation are perceived with difficulty, and the rock presents a massive aspect.

Above Indian point, which is a long, sandy and gravelly point projecting into the river from the north shore about twelve miles east of Des Joachims rapids, the rocks along the north side show in a continuous series of hills, similar in character to those just described. While the prevailing colour is reddish or reddish-grey, occasional dark hornblendic bands are seen and intrusive dikes of a dark dioritic rock occur at intervals. Along the south side of the river the shores are generally low and sandy, but occasional ledges of similar granite-gneiss appear as far as Des Joachims village. This place is at the head of navigation on the river from Pembroke. On the north side of the village a depression extends westward from the Ottawa which here comes in from the south, and this probably indicates the presence of an old channel of the river, since the water in the present channel to the south is apparently shallow past the chain of the rapids. This point is fifty miles west of Pembroke and the same distance east of Mattawa.

Returning to High View point, at the lower end of the Deep river, the south shore was examined. Similar granite-gneiss was found on all the islands south to the mouth of Sturgeon bay which is at the outlet of the Chalk River chain of lakes, the strike of the foliation being about N. 10° E. with a dip to the northwest at an angle of fifteen degrees. Similar rocks occupy the south side of the Deep river from High View west for some ten miles, and form a ridge which separates this part of the river from the chain of lakes just mentioned, and which evidently at one time formed an old channel of the Ottawa, now largely filled up with sand and gravels.

The country south from this chain of lakes to Chalk River station and along the Canadian Pacific railway, thence east to beyond the Petawawa river crossing, is largely sand covered. The rocks are exposed at rare intervals and are of the granite-gneiss variety. There is no trace of the limestones of the Grenville series nor of the associated grey gneiss. This granite-gneiss apparently occupies all the country to the north and south of the Ottawa river for many miles, and the Grenville or Hastings series appears to be almost entirely wanting.

Below the head of Sturgeon bay to the mouth of the Petawawa river the shore is composed of high banks of sand. The country south along the line of the railway is a sand plain covered with a small growth of Norway pine, but at the mouth of the Petawawa ledges of foliated granite-gneiss appear similar to that seen along the north shore. Below this the Pembroke channel contains many islets of the red foliated gneiss, and occasional outcrops of the same are seen along the south side almost down to the town of Pembroke. About four miles west of this place there are small outcrops of Calciferous dolomite which represent the western margin of the Palaeozoic basin seen on Allumette island. The shores along this part of the river are generally low and sandy or strewn with boulders.

At Pembroke the Chazy shales, capped by limestones of the upper part of the formation, come in. They continue down the river to the head of the large island at Allumette rapids. This island is composed of a greyish buff-weathering dolomite which probably represents the transition beds between the Chazy limestone and shales.

Descending the Ottawa from Pembroke the principal rock formations on both sides of the river have already been described, as also those seen along the north channel to Bryson.

The south or Roche Fendu channel past Calumet island is very rough, and though at one time used for driving timber has long been given up for this purpose in favour of the north channel. The upper two miles from La Passe to the head of the first dam is through a clay flat, with Calciferous and Chazy limestones and shales on either side.

At Sullivan island, at the head of which is a dam, the rocks are a mixture of granite, gneiss, limestone and pyroxene. The limestone is generally in small irregular bunches or patches as if caught in the intrusive masses. The associated gneiss is of the rusty variety and sometimes black or reddish grey. The granite is usually massive.

Thence down the north channel past Sullivan island to Desjardin the rocks are mostly granite and granite-gneiss with occasional patches of limestone. Below Desjardin, at the foot of La Fontaine island, the limestone again comes in in force, sometimes well banded but often mixed with granite, and dikes of other rocks in which are crystals of pyroxene, occur. Quartzite and rusty gneiss are also associated. The limestone bands are in places much twisted and broken up, and at the Muskrat portage the intricate admixture of limestone, pyroxene, gneiss and granite forms a very rough surface and almost blocks up the channel, forming a heavy rapid. This limestone is sometimes highly crystalline and white, especially when near the granite intrusions, resembling in this respect much of the Hastings series limestone along the Mississippi river, and the villages of Bryson and Portage du Fort.

Past the Barriere and the Long rapids, which form a very dangerous piece of navigation for canoes, the rocks are mostly limestones underlaid by rusty gneiss with granite dikes, and inclusions of gneiss and pyroxene. From this down to the head of the rapid at the upper end of Roche Fendu lake the limestone occupies the left bank or island shore and the rusty gneiss the right bank with an underlying dip to the north. At the mouth of the upper bay at the head of Roche Fendu lake the gneiss extends across the river, and thence down into the lake the rusty gneiss occupies both sides dipping towards Calumet island at low angles of ten to twenty degrees. At the point above the last carry at the head of the lake a heavy dike of pegmatite cuts the gneiss like a wall and has bent up the rusty gneiss to an angle of about thirty degrees along the contact. It now projects above the surface of the gneiss for several feet.

Along the shores of Roche Fendu lake sands are widely distributed. Ledges of limestone, cut by granite dikes, show at intervals, the former predominating. The islands in the lower part of the lake are mostly of granite, as also the shore to the sharp bend at the junction with the Bryson channel. The islands off the mouth of this channel are mostly of limestone, the contact between the granite and limestone being at the head of the deep bay on the west side below the point.

Thence down the river, for half a mile, limestone occurs along the south shore and in the islands in the stream, succeeded down stream by intrusive granite as far as the wing dam. Here the limestone, with interstratified bands of gneiss, again comes in, and both are cut by granite masses similar to those seen on the east end of Calumet island Below this to the bridge near Portage du Fort the rocks are a mixture of granite, gneiss and limestone, the whole intricately involved and the intrusive nature of the former is clearly seen. At the bridge and along the south side of the river anorthosite masses and dikes form a prominent feature, and thence to the lower end of the large island at Portage du Fort these rocks cut the limestone at many points, the latter forming the east end, and continuing down stream for several miles past the Cheneau rapids. On the south shore the limestones are interstratified with the gneiss, and a mass of anorthosite several square miles in extent is seen along the roads leading to Haley station and to Renfrew. All along this portion of the river the limestones are highly altered and much contorted, with numerous dikes of granite and diorite.

## AREA NORTH OF THE OTTAWA.

### PICKANOCK RIVER.

The principal branch of the Gatineau from the west in this area is the Pickanock river. It joins the former near the northeast angle of the sheet and rises in several large lakes, the most important being Lake Dumont. For a great part of its course the banks of this stream show no ledges, the shores being low and sandy. The country to the north is practically unopened for settlement and the surface in this direction is frequently occupied by heavy deposits of sand. Where the underlying rocks are exposed they consist of granite and granite gneiss and occasionally thin beds of greyish gneiss and crystalline limestone outcrop. One of the bands of the latter is seen on the road up the west side of the Pickanock in the township of Clapham. A traverse was made along this stream and an examination was also made of the lakes at its head, including Squaw, Du Mont and the Kegimaw lakes.

Around these the rocks are mostly granitic. At the east end of Du Mont lake a small exposure of pyroxenic rock was observed but no minerals of value were noticed in connexion with the outcrop. Around the Kegimaw lakes the shores are of sand and gravel, but a narrow band of limestone comes into view at the north end of the upper lake and extends across to the headwaters of the south branch of the Desert river. Ridges of granitic rock traverse the district, but much of the country is densely wooded and rock exposures are few.

In the townships of Low and Aylwin large areas are also occupied by deposits of sand and clay. Among the most extensive of these are the Kazabazua plains which extend from the village of Kazabazua near the Gatineau river for about six miles west to the line of Alleyn township. Rock outcrops are rarely seen in this area. Occasional exposures of red granite are noted but the underlying formation is probably for the most part crystalline limestone. The sand deposits extend north from Kazabazua to the Pickanock river and in fact are continuous to the sandy plains of the River Desert. The country is comparatively level or broken by low elevations.

The evidence of the intrusive character of much of the granite of the Ottawa district through the grey gneiss and associated limestone of the Grenville-Hastings series is very conclusive. There is no doubt as to the later age of portions of the granitic rocks at least. The question of the separation of certain portions of this granite mass under the head of lower or fundamental gneiss is one, however, to be carefully considered. This aspect of the question has been discussed in several recent papers by Messrs. Adams, Barlow and the writer of this report.

From the latest study of the crystalline rocks of the district north of the Ottawa, as well as in the country to the south and west in the counties of Renfrew and Hastings, it would appear that portions at least of the granite-gneiss represent the true fundamental series, and that, owing to softening of the old crust, the newer Grenville and Hastings rocks in places sank down into the lower gneiss, and that the irregular outcrops of the latter now represent the remains of these series that have escaped the enormous denudation which has affected the whole area. In this case it may fairly be assumed that the large areas of the granite-gneiss may be assigned to the Laurentian proper. The presence of other masses, however, may be clearly regarded as true intrusives of later date than the rocks of the Grenville series. Of these several varieties are noticed, such as anorthosite, pyroxenic rocks, pegmatite, diabase and certain granites. Though the latter in many respects resemble physically much of the older granite-gneiss they are as a rule much more limited in extent and tend to a more massive structure. The gneisses associated with the limestones may be regarded as altered sedimentary rocks, their metamorphic characters being due to regional alteration in most cases, but locally more highly altered by the action of the newer intrusives. This feature is frequent in many of the limestones both of the Grenville and Hastings series.

From an examination of all the features of the problem it has now been generally accepted that the Laurentian should be confined as far as practicable to the fundamental granite-gneiss, that the rocks of the Grenville and Hastings series should be regarded as a portion of the Huronian and represent the lowest members of that syste in eastern Ontario and in Quebec adjoining, and that the upper pa of the Huronian is represented by the more schistose portion seen the area farther south and west. In this manner much of the diff culty hitherto experienced in interpreting satisfactorily the gre problem of the crystalline rocks disappears.

## AREA SOUTH OF THE OTTAWA.

In the district south of the Ottawa there is a greater variety in th rock formations. Large areas or outcrops of the Palaeozoic series ar seen at a number of places and these range from the Potsdam to th Trenton.

Exploratory work was carried on in this area at an early period i the history of the Geological Survey. The work of Mr. A. Murray i 1853 on the Bonnechère and the Petawawa rivers, the results o which are given in the Report for 1854, has already been alluded t In connexion with the examination of the latter stream, which wa followed downward from the height of land at the source of th Muskoka, several interesting geological features were brought out.

In character the granite-gneiss, which is the principal rock see along the Petawawa, as stated by Mr. Murray, is very similar to that seen along the upper Ottawa. He describes it as a "brick-red ferru ginous rock composed chiefly of feldspar and quartz, which in som parts has the aspect of an obscure hornblende gneiss, and in other that of a fine-grained syenite; and the gneiss in the vicinity, whe the stratification could be distinctly made out, being always shattered and dislocated, I was disposed to consider the red rock intrusive."

As for its distribution along the course of this river Mr. Murray remarks for that portion of the river below Cedar lake, which i forty-five miles in a straight line west from its junction with th Ottawa, "this red rock was seen at intervals from Cedar lake to th mouth of the river, frequently forming bold vertical cliffs which i one instance rose perpendicularly from the river to the height of 250 feet. The rock has a conchoidal fracture and is usually intersecte by small greenish coloured veins, supposed to be chlorite, which als penetrate the adjacent gneiss. The black hornblende rock is usuall very pyritous, and the associated red masses are frequently highly ferruginous, at times giving a bright red colour to the soil on th surface. Where the gneiss comes in contact with the red rock it ofte so nearly resembles the adjoining mass that it can only be distin guished from it by closely observing the continuity of the parall arrangement of the mineral layers, which ceases at the junction. This was especially observed at the lower end of Cedar lake, where the probability of the mass being intrusive first suggested itself.

"At the northern sweep taken by the river below Lake Travers (which is about twenty miles below Cedar lake) a portion of the gneiss is dark green, and appears to contain epidote, while other portions are dark-grey, with many disseminated garnets. The fine-grained and supposed intrusive red rock is in close proximity with both these varieties, being seen in the river both above and below where they occur, but whether interstratified with, or intersecting, the gneiss, was not satisfactorily ascertained."

From the above descriptions of the rocks along the Petawawa, which flows approximately parallel to the Deep River portion of the Ottawa at a distance of fifteen to twenty miles south, it would appear that these rocks are continuous across the entire distance, and that there are occasional bands of the greyish and garnetiferous gneiss, but that these are almost entirely removed by denudation or by absorption in the lower or intrusive mass, which some have regarded as the fundamental gneiss. Of the rocks along this river Mr. Murray remarks that "they are so generally affected by dislocations and disturbance, especially below Cedar lake, that the attitude displayed by the stratified portions is not to be relied on, except for short distances."

### BONNECHERE RIVER.

The examination of the Bonnechére river, which intersects the southern part of the map-sheet from Golden lake to its junction with the Ottawa near Castleford, about twelve miles west of Arnprior, was also made by Mr. Murray in the same year.

This river for the lower part of its course flows between banks of clay with occasional outcrops of the crystalline rocks, but, near the Ottawa, exposures of Calciferous dolomite are seen along the road east of the road bridge and on the shores of the Ottawa river, while considerable areas of the newer formations, including Chazy, Black River and Trenton, occur at intervals nearly to the foot of Golden lake. In this distance the navigation of the Bonnechére is broken by four heavy chutes and by stretches of rapid water.

The elevation of the Ottawa at the mouth of the Bonnechére, taken from Mr. James White's Dictionary of Altitudes, is given as 239·3 feet for low water and 246 feet for high water level in the river. From the same authority the elevation of the water at the outlet of Golden lake is given as 560 feet. This is above mean sea-level.

According to the observations made by Mr. Murray the elevation of the mouth of the Bonnechère, taken from the Report of Sir William E. Logan, 1845, is given as 233·09 feet, and that of Golden lake from Murray's measurements is 515·92 feet, showing a discrepancy of 37·87 feet, taking the low water measurement of the Chats lake.

At the first chute, which is about one mile above the mouth of the river, the rise is given by Murray as about thirty-two and a half feet. The rocks here are, for the most part, crystalline limestone with some gneiss inclusions, the whole presenting the banded appearance of the Arnprior marbles, and the dips, while varying somewhat, are to the E. or S 65° E. < 20°.

Ascending the river the second fall is at the town of Renfrew, where there is a descent of 82·21 feet. The rocks here are also largely of the limestone division, but hornblende schists and gneisses are seen in close proximity. The third fall is at the village of Douglas where the descent, including that caused by the rapids, is about twenty-seven feet. The descent here is over limestone and shales of Chazy age, and these are capped to the south by other limestones of Black River and possibly of Trenton age.

The fourth chute is about midway between Douglas and Eganville. The rocks at this place, and for some distance below as well as above the falls, apparently belong to the Chazy formation, including the characteristic shales at the base, and fossiliferous limestones in patches upon these. No fossils characteristic of the Black River formation were here recognized. The total descent at this chute and in the rapids associated with it is about sixty-five feet.

A succession of rapids and pitches between Eganville and Mud lake gives a descent of about sixty-four feet, and there is a rise westward of about six feet to the foot of Golden lake. The rocks at Eganville in the river are Chazy shales but below this along the stream there are outcrops of Black River and of Trenton limestone, while, on the hill to the south, the Black River forms a somewhat broad escarpment, the limestone extending beyond the line of the Grand Trunk railway. The formations along this part of the river are affected by several local faults.

Around the shores of Golden lake there are large areas of sand drift and this feature is also seen around the shores of Round lake to the northwest. Ledges of gneiss, sometimes garnetiferous, show near the foot of the former lake on the south side with a dip of S. 55° E. < 15°. The associated beds are highly quartzose, and on the low point to the west of the outlet there are outcrops of crystalline limestone. On the shore along the line of the Grand Trunk railway a mass of red granite, seen in a cutting, traverses the gneiss and limestone and should, therefore, be of subsequent date.

The south shore of the lake shows occasional outcrops of the gneiss to the mouth of Brennan creek which flows in near Killaloe station on the Grand Trunk. Masses of granite cut the gneiss at many points and break the continuity of the banded series. Along the railway the cuttings are for the most part in sand and gravel, but near Killaloe well banded gneiss appears to dip S. 50° E. < 35°-50°. The west end of Golden lake is low and somewhat marshy and ledges are not seen.

A high ridge of gneiss rises along the north side of the Bonnechère above Golden lake, which towards Round lake recedes to the north west. The area to the south is low.

Around the shores of Round lake the rocks are largely concealed by sand. A ridge of red granite-gneiss appears at the upper end where the Bonnechère enters the lake with a dip of S. 80° E. < 15°. This is a foliated granite resembling the fundamental gneiss. The south side of the lake is all well stratified sand and gravel in low cliffs, and a range of hills, probably of granite-gneiss, rises a short distance inland.

The intrusive character of much of the granite is well seen in the area along this portion of the Bonnechère waters. No trace of limestone was recognized west of the small ledges in the lower end of Golden lake.

The western townships in this area, including North and South Algoma, Fraser, Alice, MacKay, Petawawa, Buchanan and Wilberforce are occupied to a large extent by sand deposits. These are underlaid by clays in which no trace of marine organisms have as yet been found. The underlying rock where exposed is for the most part gneiss. The limestone is not exposed west of the township of Wilberforce where the last outcrops in this direction were observed along a road from Golden lake to the west end of Lake Doré, though occasional areas of the calcareous rocks may lie concealed beneath the drift. It would appear, however, that this area is occupied generally by the gneissic-granites which have been described in the area along the Petawawa and the upper Ottawa.

Farther east, however, in the townships of Ross, Horton and MacNab, the limestones are well developed. These appear to be a portion of the great Gatineau belt of the north side of the Ottawa which has been cut off in part by the great granitic mass of the King Mountain ridge and its extension west into Clarendon township.

In the areas south of the Ottawa the limestone presents features somewhat different from those seen in the Gatineau and Grenville district. It has frequently a banded aspect from the presence of minute layers of finely comminuted graphite, and this banded or striped feature is found in much of the calcareous division south of the Ottawa, so much so that the name "striped limestone" is frequently employed to distinguish these rocks.

They are also associated with bands of hornblende schistose rock and frequently with mica schists which are a pronounced feature farther south along the line of the Kingston and Pembroke railway. A portion of this schistose series crosses the Ottawa above the Chats falls and is seen near the Bristol iron mines and along the line of the old horse railway past the falls and rapids, associated with epidotic and hornblende rocks. A large portion of the southern area is occupied by outliers of Palaeozoic formations.

About Renfrew the limestones of this character are well displayed, as also to the north in the area between this place and Portage du Fort. While these are cut in many places by masses of granite and other intrusive rocks, they are also associated with areas of greyish gneiss and hornblende schists. The limestones are, as a rule, more dolomitic and are in places highly tremolitic, a feature well seen along the line of the Kingston and Pembroke railway between Renfrew and Calabogie lake. This feature is also seen in some parts of the Gatineau district. Some of the limestones, as in the township of Ross, are true crystalline dolomites with more than forty per cent of magnesian carbonate. This rock should be well adapted for the manufacture of chemical pulp. The schistose portion of these rocks, which have been described in Reports by Vennor under the head of the Hastings series, (Ann. Rep. 1876-77) is much more extensively developed in the southern part of Renfrew county and in the counties of Frontenac and Lanark adjacent to the south.

Much information is given in Vennor's report already mentioned regarding the distribution of the various gneisses and crystalline limestones in the county of Pontiac north of the Ottawa river, (See pages 277-296.) It is scarcely necessary to repeat the descriptions of the rocks found in this area, since the conclusions regarding the structure have since that date been very considerably modified, and their physical features have been discussed in the Report on the Grenville map sheet.

## PALAEOZOIC FORMATIONS.

The Palaeozoic rocks found in the area of the accompanying map-sheet range from the base of the Calciferous to the Trenton limestone. They form the remnant of the western margin of the great Ottawa basin and are found at intervals along the Ottawa and also as scattered outliers in the townships of Bromley, Stafford and Wilberforce, as well as at a number of points along the Bonnechère river. Near Ottawa city they occupy the north shore of the river in Hull and a part of Eardley townships, and on the south side are seen along the river in March, Torbolton and Fitzroy townships. A small outcrop of Calciferous dolomite is seen about two miles northeast of the village of Portage du Fort resting upon granite and diorite rocks, by which they have apparently been somewhat altered.

### POTSDAM AND CALCIFEROUS.

The only outcrops of the Potsdam yet recognized in this area are in the rear of the village of Quio on the north bank of the Quio river. Granite gneiss occupies the bed of the stream at the mill on the road crossing, but a short distance above this the Potsdam shows in low ledges overlaid by Calciferous dolomite. A quarry has been opened in the sandstone and the rock is used locally for building purposes. The strata are in a horizontal attitude.

The area along the Ottawa river between Hull and the foot of Chats falls, of which the outcrops near Quio represent the northern margin, is basin-shaped The Calciferous dolomite just described shows along the north shore of the river from a point fifteen chains east of the latter village, both along the road and in occasional outcrops on the shore, while the formation is overlapped by the Chazy shales in the village itself. The Calciferous is here exposed along the road for fifty chains, resting in thin strata upon granitic rocks where it fills up inequalities of the surface, the sandstone being absent at this place. Much of the shore east of this where rock exposures are seen is occupied by granite, but this is often concealed by marine clays, in which nodules like those of Greens creek are found, containing the skeletons of fishes.

Below the mouth of Breckenridge creek, which is about seven miles west of Aylmer, a narrow margin of the dolomite occupies the shore beneath the Chazy shales with an exposed breadth of several hundred yards inland, and shows as far east as the Cedars a mile west of that village, when the Chazy reaches the shore and continues east nearly to Tetreauville.

On the south shore of the river the Calciferous dolomite comes into view about two miles west of Britannia and is thence seen to within a mile and a half of Berry wharf where it passes upward into the basal beds of the Chazy formation which is here a coarse sandy grit. The dolomite is seen along the roads in the western portion of Nepean township underlaid by the Potsdam sandstone; and also about South March corners. From this place it is exposed along the road west to Dunrobin post office, and it also occupies much of the flat country between this road and Constant creek in the direction of Berry wharf until it is covered by the rocks of the Chazy formation.

Along the shore of the Ottawa the Chazy shales extend west to a point about two miles beyond Berry wharf and here pass up into the Chazy limestone through transition beds which have a thickness of about twenty feet. The Chazy limestone then continues for about ten miles but gives place to the shales about three miles east of the Ferry landing opposite Quio village. The Chazy limestone outcrops inland and is capped by the Black River formation in the northwest portion of Torbolton, which forms the summit of the escarpment in this direction. The shales continue along the shore to near the mouth of Carp river, a short distance below the village of Fitzroy Harbour, where the Calciferous dolomite again comes to the shore and here rests upon the crystalline rocks which form the Chats falls.

While the strata along this part of the Ottawa are all nearly horizontal, several low anticlines are seen at intervals. Heavy deposits of sand occur about the mouth of Constant creek and around Big and Sand bays. This basin of Palaeozoic rocks is bounded on the south by a ridge of granite gneiss and crystalline limestone which extends east from the foot of Chats falls through the northern portion of the townships of Fitzroy, Huntley and a portion of March into the western part of Nepean, terminating about ten miles west of Ottawa city.

The difference in elevation between the foot of the Chats falls and the lake expansion of the river at the head of the rapids has already been stated as about fifty feet, the distance being three and a half miles. The Calciferous dolomite is seen along the shores of the river above the rapids resting upon the gneiss and crystalline limestone. The Chazy shales come into view about two miles west of the town of Arnprior. There would, therefore, appear to be a vertical uplift of the strata for at least fifty feet, and probably even more than this amount. That such an uplift has taken place in the area south of the river is also probable from the fact that the Potsdam sandstone seen at the Quio village is found on the summit of the ridge of crystalline rocks in the northern part of the township of Fitzroy at an elevation of several hundred feet above the river level.

On the north side of the Ottawa the Calciferous dolomite is distributed in irregular patches on the crystalline rocks nearly to Norway bay, opposite the village of Sand Point, which is on the south side of the river. It shows in several small islands in the river and on the south side is seen above Sand Point near the mouth of the Bonnechère, and for several miles east of that place in flat ledges along the shore until it is capped by the rocks of the Chazy formation. The regularity of the strata is much affected in this area by the presence of several faults, one of which is seen in the west part of the town of Arnprior where the Calciferous dolomite is in contact with limestones of the Hastings series, and a deposit of red hematite which has been mined in former years occurs along the line of contact.

Above the mouth of the Bonnechère the Calciferous rocks are not exposed, the crystalline limestone and gneiss appearing along the shore on both sides of the Ottawa, with the exception of the small outliers to the east of Portage du Fort.

The outcrops of the Calciferous in this area are so detached that no estimate as to the thickness of the formation has been attempted. It is, however, much less in apparent volume than in the outcrops along the lower portion of the Ottawa river.

## CHAZY.

The division of this formation into a lower portion embracing the sandstones and shales, and an upper part consisting of limestones, has been made wherever practicable.

Measurements were made to determine the thickness of this portion in the area on the south side of the Ottawa below Fitzroy Harbour in the escarpment opposite Quio village where the shales are well developed. Tho base of the formation is beneath the water but there are about 100 feet of shales exposed in the rise south of the river to the passage into the overlying limestones, so that if an additional amount of twenty-five feet be allowed for the portion from Quio village to the south shore the total thickness of the lower division of shales would be about 125 feet. This would not differ much from the estimated thickness at Aylmer.

The thickness of the limestone division could not be ascertained here, but an estimate of the thickness on the roads east of Fitzroy Harbour gave a volume for the upper member of the formation of not far from 100 feet to the base of the fossiliferous Black River limestone.

The distribution of the Chazy in the basin west of Ottawa has already been given to a large extent under the head of Calciferous. Along the ridge south of Berry wharf the shales so well seen along the shore are capped on the crest of the rise by the limestones of the upper division, while the shales again appear in the valley of Constant creek to the south. The shales show east of Fitzroy Harbour in the slope of the hill beyond the Carp river, and are here capped by the limestone along the roads which cross the escarpment to the northeast.

Above Arnprior the contact of the Chazy shales with the Calciferous on the shore is seen about half a mile east of Braeside, the underlying Calciferous dolomite dipping southwest < 2°. The shales are thence exposed along the shore and in the hills to the south for several miles and form the steep ascent south of Sand Point, the upper part of which is capped by Chazy limestone which passes up into the Black River formation along the top of this ridge, the surface breadth being nearly a mile and a half.

The shales are also seen along the Canadian Pacific railway west of Sand Point station until they are terminated by the underlying Calciferous of the area east of the Bonnechère river, near Castleford station.

Outcrops of this formation are seen along the Bonnechère at several points. They are well exposed at the third chute near Douglas village and for several miles along the stream westward towards the fourth chute where they are overlapped by the Chazy limestones. They also show in the river at Eganville but the areas here are somewhat faulted and the outcrops are abruptly terminated.

Along the upper Ottawa they have already been referred to as occurring on Allumette island and on the west end of Calumet island. They are seen also along the eastern shores of Lake Doré where they form the lowest member of an outlier of these rocks which pass upward into the Black River formation.

### BLACK RIVER AND TRENTON LIMESTONE.

The outcrops of this formation in the area south of the Ottawa are quite numerous and are widely distributed. They occur sometimes as isolated outliers with boldly scarped sides, at other places they represent the upward passage from the Chazy limestones, as in the area east of Fitzroy Harbour and to the north of the town of Aylmer.

Along the south side of the Ottawa river the Black River limestone is seen on the ridge south of Buckham bay which is about six miles east of Quio. The Chazy limestone occupies the shore at this place, and the Black River formation has here been extensively quarried. Large quantities of excellent stone were removed for the construction of the old canal past the Chats falls about forty years ago, and later for bridge construction on the Pontiac and Pacific railway. The limestones of this formation have a considerable development in the northern portion of Torbolton township and pass into the *Receptaculites* beds which represent the lowest portion of, or transition beds to, the Trenton formation proper.

Ascending the Ottawa river the Black River formation is next seen on the top of the ridge south of Sand point about five miles west of Arnprior. The rocks here are highly fossiliferous and certain bands hold an abundance of *Tetradium fibratum*, a characteristic fossil of these limestones. These rocks form the crest of a ridge extending south for over a mile from the river, and on the south flank, which drops somewhat abruptly to the clay flat inland, are several quarries from which also fossils peculiar to the formation have been obtained.

The continuation of these rocks westward can be traced for several miles. They show on the crest of a ridge south of the river near the line between MacNab and Horton townships where they also overlie the Chazy limestone. These rocks are readily recognized by their peculiar physical aspect, weathering in broad, jointed, flaggy, thick masses, and in most cases contain fossils which are mostly determinable.

In the townships of Bromley and Wilberforce a large area of this limestone is found. It extends from the east side of Lake Doré in a southeast direction for about eleven miles with a breadth in places of nearly three miles, overlaid in part by limestones of Trenton age. The outcrops cannot be traced continuously, however, owing to great areas of drift. On the south side of the Bonnechére they form a ridge which rises a short distance from the village of Douglas near the crest of the hill crossed by the road thence to Renfrew, and here cap the Chazy limestone. The Black River limestone extends east from this place for nearly three miles, showing along the road in broad bare ledges, which is a feature generally seen in outcrops of these rocks, their massive character being in marked contrast to the softer and more easily decomposed strata of the overlying Trenton.

Another conspicuous area of these bare rocks is seen to the southeast of Eganville where it is crossed by the Grand Trunk railway. An estimate of the thickness of the limestones at this place gave not far from 100 feet.

In the township of Stafford an important outlier of this limestone, occupying several square miles, is seen to the south of Muskrat lake and river. It has steeply scarped sides on the north and west, and rests on the Chazy limestones on the south. Large quarries are found on the northwest flank overlooking the railway near the Muskrat Lake crossing, from which fossils have been collected.

Along the Ottawa river above Calumet island the Black River limestone is seen at Séche point about three miles west of Coulonge village, and at the point below the boom about three miles farther west. Fossils are found at both places from which collections have been made.

The outcrops at the foot of Allumette island (Paquette rapids) have already been referred to.

Several other isolated outcrops of these rocks are seen in the area south of Bonnechére. They are beyond the limits of the map-sheet and may be referred to merely as showing the widespread character of the rocks before their removal by denudation. They are found on the west side of Clear lake, and on the road east of this towards Dacre near the crossing of Constance creek. On the shores and roads around Calabogie lake also these rocks are seen, all indicating a wide expansion of the rocks of the Ottawa Palaeozoic basin in this direction at some early time. The more recent formations which now occur near the city of Ottawa have all been removed with the exception of a small area, near Clear lake, of Utica shale.

Several large collections of fossils, chiefly from the outcrops of the Black River formation, were made by Mr. L. M. Lambe and the writer, in 1896. These have been determined by Mr. Lambe, and the lists from the several localities are here given.

From Stewart's quarry on lot 19, range XI, and from Gillis's quarry, lot 2 , range B, township of McNab.
*Columnaria halli*, Nicholson.
*Tetradium fibratum*, Safford.
*Monotrypella trentonensis*, Nicholson, (sp.)
*Leperditia canadensis*, Jones.
*Orthis testudinaria*, Dalman.
*Strophomena incurvata*, Shepard.
*Orthoceras*, sp.

From hill behind Sand Point village, lot 18, range A, same township.
*Columnaria halli*, Nicholson.
*Tetradium fibratum*, Safford.

*Crinoid stems*, (remains of)
*Leperditia canadensis*, Jones.
*Bathyurus extans*, Hall. (caudal shield of small specimen).
*Asaphus platycephalus?* Stokes. (portion of caudal shield).
*Orthis testudinaria*, Dalman.
*Strophomena incurvata*, Shepard.
*Rhynchotrema inaequivalvis*, Castelnau = *R. increbescens*, Hall.
*Zygospira recurvirostra*, Hall, (sp.)
*Murchisonia gracilis*, Hall.

From quarry on hill south of Douglas village, lot I, range VIII, Bromley township.

*Stromatocerium rugosum*, Hall.
*Columnaria halli*, Nicholson.
*Streptelasma corniculum*, Hall.
*Tetradium fibratum*, Safford.
*Crinoid stems*, (remains of)
*Pachydictya acuta*, Hall. (sp.)
*Orthis pectinella*, Conrad.
*Ctenodonta astartiformis*, Salter.
*Strophomena incurvata*, Shepard.
*Zygospira recurvirostra*, Hall.
*Actinoceras bigsbyi*, Stokes.

From Cobden road, one mile and a half northwest of Douglas, lot 10, range VIII, Bromley township.

*Stromatocerium rugosum*, Hall.
*Streptelasma corniculum*, Hall.
*Crinoid stems*, (fragments)
*Leperditia canadensis*, Jones.
*Orthoceras multicameratum ?*, Emmons.

Forks of road to Cobden, lot 12, range VII, Bromley township.

*Stromatocerium rugosum*, Hall.
*Columnaria halli*, Nicholson.
*Streptelasma corniculum*, Hall.
*Tetradium fibratum*, Safford.
*Crinoid stems*, (fragments)

Cross roads, lot 16, range VI, Bromley township, four miles south of Cobden.

*Solenopora compacta*, Billings. (sp)
*Streptelasma corniculum*, Hall.
*Protarea vetusta*, Hall. (sp.)

At top of north slope of hill southwest of Cobden, lot 16, range VI, Bromley township.

Probably lower beds of Trenton or transition.

*Receptaculites occidentalis*, Salter.

*Asaphus* (*Isotelus*) *maximus*, Locke, = *A megistos*, (portion of cephalic shield.)

*Ceraurus pleurexanthemus*, Greene, (cephalic shield.)

*Ptilodictya maculata*, Ulrich.

*Orthis testudinaria*, Dalman.

*Orthis pectinella*, Conrad

*Strophomena incurvata*, Shepard.

*Rhynchotrema inaequivalvis*, Castelnau.

? *Pterinea elliptica*, Hall. (sp.)

Munroe's quarry, lot 19, range 2, Westmeath tp.

*Stromatocerium rugosum*, Hall.

*Columnaria halli*, Nicholson.

*Streptelasma corniculum*, Hall.

*Tetradium fibratum*, Safford.

*Crinoid stems*, (fragments)

*Strophomena incurvirostra*, Shepard.

*Camerella panderi*, Billings.

*Murchisonia bellicincta*, Hall.

*Murchisonia gracilis*, Hall.

*Actinoceras bigsbyi*, Stokes.

*Orthoceras*, sp.

Ridge south of Mud creek, lots 12-13, range 11, Stafford township.

*Solenopora compacta*, Billings, (sp.)

*Receptaculites occidentalis*, Salter.

*Streptelasma corniculum*, Hall.

*Crinoid stems*, (fragments.)

*Strophomena incurvata*, Shepard.

*Rhynchotrema inaequivalvis*, Castelnau.

*Ctenodonta contracta*, ? Salter.

*Pleurotomaria progne*, Billings.

*Pleurotomaria subconica*, Hall.

*Murchisonia bellicincta*, Hall.

*Murchisonia gracilis*, Hall.

*Bellerophon sulcatinus*, ? Emmons.

*Maclurea logani*, Salter.

*Orthoceras*, sp.

*Cyrtoceras falx*, Billings.

From quarry near Eganville, lot 18, range VIII, Wilberforce township.

- *Columnaria halli*, Nicholson.
- *Streptelasma corniculum*, Hall.
- *Crinoid stems*, (fragments.)
- *Asaphus platycephalus*, (caudal shield), Stokes.
- *Monotrypella trentonensis*, Nicholson, sp.
- *Escharopora recta*, Hall.
- *Stictopora acuta*, Hall.
- *Orthis testudinaria*, Dalman.
- *Strophomena incurvata*, Shepard.
- *Plectambonites sericea*, Sowerby.
- *Rhynchotrema inaequivalvis*, Castelnau.

From loose specimens near quarry.

- *Streptelasma corniculum*, Hall.
- *Calapœcia canadensis*, Billings.
- *Batostoma ottawaensis*, Foord.
- *Orthis testudinaria*, Dalman.

From boulders on ridge south of Clear lake.

- *Stromatocerium rugosum*, Hall.
- *Columnaria halli*, Nicholson.
- *Calapœcia canadensis*, Billings.
- *Orthis testudinaria*, Dalman.
- *Maclurea logani*, Salter.

## SURFACE GEOLOGY.

The surface geology of this district is characterized by the same features as described for the map-sheet adjacent on the east. Great areas of clays, sands and gravels are conspicuous at many points. Some of these show their marine origin by the presence of shells, the remains of fishes, &c., while other large areas apparently on the same horizon are destitute of such organisms.

Clays are well exposed in the eastern portion of the area along the Gatineau Valley railway as far north as Venosta, beyond which the great extent of sand known as the Kazabazua plains comes in, and the clays are largely concealed. In fact a great part of the northern half of the map-sheet shows these sands over many miles from the Gatineau river across the Black and Coulonge rivers and out to the Ottawa at the foot of the Deep river, where they cross and are seen on the south side in the Chalk and Petawawa River plains. These sand plains, broken by occasional rocky ridges, extend south beyond the Bonnechère.

They occupy large portions of Alice and Fraser townships and are conspicuous features around Golden and Round lakes.

East of the Ottawa river, from Portage du Fort to Bryson, they are found throughout the southern part of the townships of Clarendon and Bristol. The sands are reddish and probably derived from the decay of the granites and gneiss of the northern country, while the clays underlying are presumably due to the decay of the Palaeozoic limestones which probably once occupied all the country now forming the basin of the Ottawa, the scattered remains of which are seen in the outliers already described.

The surface geology of the area along the valley of the Ottawa has been well described by Dr. R. Chalmers in the Report for 1897, and lists of striae have there been given. From his observations, as also from other notes pertaining to the area to the north and south, it appears that three sets of ice markings can be recognized along the river. Among these may be mentioned the following

| | | |
|---|---|---|
| NORTH OF THE OTTAWA RIVER near Sheenboro P.O. | | S. 25 E. |
| Two miles west of Waltham P.O. | | S. 60 E. |
| Chichester, opposite Pembroke | | S. 20 E. |
| Road two miles N. E. of Vinton P.O. | | S. 30 E. |
| Shore road about four miles E. of Portage du Fort | S. 30 E. | S. 15 E. |
| Near Parkman P.O. two miles N.E. of Portage du Fort | | S. 30 E. |
| Road one mile east of Billerica P. O. | | S. 55 E. |
| Road half a mile west of Wakefield P. O. | | N. and S. |
| SOUTH OF THE OTTAWA RIVER — | | |
| Near mouth of Petawawa river | | S. 25 E. |
| East line of Ross, two miles south of river | | S. 20 E. |
| Road south side of river, one mile west of Portage du Fort bridge | | S. 45 E. |
| Four miles south of Cobden | | S. 20 E. |
| Roads between Cobden and Lake Doré | | S. 40 E. |
| In vicinity, on several outcrops | S. 25 E. | S. 40° E. |
| West part of Westmeath township | | S. 30 E. |
| Near Stafford post office | | S. 30° E. |
| Garden of Eden, east part of Horton township | | S. 42° E. |
| On road near Forester falls, " | | South. |
| One mile southeast of Forester falls | | S. 15 E |
| Two miles west of Healy station, C.P.R. | | S. 40 E. |
| One mile N.W. of Lake Doré | | South. |
| Two miles N.W. of Lake Doré | | S. 10 W |
| Near Rankin post-office | | S. 10 W. |
| One mile N.E. of Doré lake | | South. |
| South side of Mink lake | | S. 10° W. |
| Southeast end of Mink lake on road | | S. 10° E. |
| Road north of Mud lake, Bonnechère river | | S. 30° W. |
| Road Eganville to Clear lake, midway | | S. 35° W. |
| Near Alice post-office | | S. 10° E. |
| Near Renfrew | | S. 55° E. |
| South side of Golden lake on road | | S. 25° W. |

Kames and morainic ridges were noted at several places. Among these may be mentioned,

| | |
|---|---|
| Road from Golden lake to Eganville, course | S. 80 E. |
| Near Caldwell station, Grand Trunk railway | S. 75 E. |

Marine shells were found in the clays and overlying gravelly beds near Bryson; near Forester falls; top of ridge south of Sand Point, and on the road north from Kinburn on summit of old ridge; but over large areas of these deposits no trace of organisms was detected. In nodules from the shore of the Ottawa river below Quio remains of fishes similar to those collected at Greens creek are obtained, and similar shaped nodules are found along the shores of Coulonge lake, from which also organisms have been recorded.

## ECONOMIC MINERALS.

### *Iron.*

The only workable deposits of iron yet found north of the Ottawa in this area are at the Bristol mines, on lots twenty-one and twenty two, of the second range of Bristol township, Pontiac county, Quebec. The ore here is a magnetite, occuring in pockety or lenticular masses, some of which are of considerable extent. The associated rocks are micaceous and hornblende schists, cut by reddish granite. The ore is more properly a mixture of magnetite and hematite, the streak ranging in colour from reddish to black. The colour of the ore is generally a dark steel grey and is readily attracted by the magnet. The total percentage of metallic iron according to assay by Dr. Harrington is 58.37, with 1.46 of sulphur and but traces of phosphorus. A large amount of work has been done at this place. A railway four miles in length was built to connect with the Pontiac and Pacific Junction railway at Billerica station, and large roasting furnaces were constructed by which the greater part of the sulphur in the ore was removed.

From a paper on "Possibilities of Iron Manufacture at Ottawa" by Mr. John Birkenbine, read at the Ottawa meeting of the American Institute of Mining Engineers in 1889, the following particulars regarding this property are taken.

"The Bristol mines in Pontiac county, Que., are connected by railway with Ottawa, thirty-five miles distant, and present very favourable evidences of a deposit of magnitude from which over 10,000 tons of ore have been won. Some 4,000 tons of this ore were shipped to and smelted in the Charlotte furnace in New York. The ore is a rich, dense magnetite, unusually low in phosphorus, but carrying sulphur in such quantity as to require roasting, for which the property is admirably equipped. There are now in place two Taylor Langdon roasters, and one Westman kiln, modified by Mr. Ernest Sjöstedt, resembling in many points what is known as the Davis Kolby kiln. These kilns are operated by gas generated in Langdon producers. The mine has been opened to a depth of 150 feet, with drifts along the strike of 150 feet and across the vein of fifty feet in one place and thirty and sixty feet in length in another locality, while test-pits and magnetic surveys indicate a deposit of considerable magnitude. The following analyses show the composition of the ore both raw and calcined.

*Raw.*

| | A. | B. | C. |
|---|---|---|---|
| Iron | 58.37 | 62.15 | 61.987 |
| Sulphur | 1.46 | 0.97 | 2.406 |
| Phosphorus | trace | .0075 | .006 |
| Silica | 11.45 | 8.52 | 7.32 |
| Lime | 3.91 | | |

*Roasted.*

| | D. | E. | F. | G. |
|---|---|---|---|---|
| Iron | 62.5 | 62.525 | 62.87 | 63.24 |
| Sulphur | 0.521 | 1.1673 | 2.221 | 1.08 |
| Phosphorus | .004 | | 0.014 | |

A. Geological Survey of Canada.
B. R. Richards, Boston.
C. Booth, Garrett and Blair.
D. Lackawanna Iron and Coal Co.
E. A. McGill, Ottawa.
F. and G. Troy Iron and Steel Co.

The latest experiments with the roasters show, according to Mr. McGill's analyses, that the sulphur was reduced to 0·279.

Further remarks on the treatment of these ores will be found in the Annual Report of the Geological Survey, 1888–89, on "Mineral Resources of Quebec."

Indications of other deposits of ore are found in connexion with this belt of rocks between this locality and the shore of the Ottawa near the ferry to Braeside. These iron bearing rocks here form a somewhat extensive belt, and pockets of the ore have been reported as occurring in this direction, though the area has apparently never been properly prospected.

Indications of iron ore are found at several points in the township of Litchfield and also on Calumet island. Those seen have no great surface development and some at least are presumably of but little economic value. It is quite possible, however, that in the great belt of granitic and dioritic rocks which occur in this area other bodies as important as those at Bristol may be found.

### *Galena and Blende.*

The principal deposits of these minerals are found near the eastern end of Calumet island. Mining has been carried on here for some years at irregular intervals on pockety masses of zinc blende and galena which occur in connexion with dioritic and granite rocks. These cut across the rusty gneiss and crystalline limestone of the district. There does not appear to be any true vein structure to these deposits of ore, some of which are of large size yielding several hundred tons of shipping material, but much of the output requires careful cobbing and concentrating to be profitably handled.

These deposits have been referred to in several of the summary reports on this district and analyses of the galena have been given. All work has been suspended on this property for several years.

In the southern part of the island, on lots 12 and 13 of range IX, some work was done, and in 1898, was continued on a mass of pyritous ore which held in places a small percentage of nickel. The ore occurred in connexion with dikes of diorite which traverse the rusty gneiss and limestones of the Roche Fendu channel of the Ottawa river, and the outcrop was marked by a similar rusty covering to that seen at the blende mines farther east.

A shaft was sunk on the deposit to a reported depth of over seventy feet, but the quantity of the minerai was not sufficient for economic development and the work was abandoned. Indications of similar minerals are seen at several places on the island in connexion with intrusive masses through the grey and rusty gneiss, but the deposits in the eastern portion appear to be the most extensive.

### *Mica.*

The development of the Mica industry has been confined to the last fifteen years. At the time of the publication of the Report on the Mineral Industries of Quebec," 1888-89, no mines of this mineral were being operated in the province or, if so, on a very limited scale. The mode of occurrence has already been fully discussed in previous reports and attention need only be directed to the localities where workable mines are in operation. (See Bulletin on Mica, 1904.)

Of these the most important mineral belt is confined to the town ships adjacent to the Gatineau river. Farther west occasional deposits have been reported and some of these have been worked to a limited extent though without very satisfactory results.

One of these deposits is located in the southwest corner of the township of Huddersfield near the outlet of Hickey lake about twelve miles back from the village of Coulonge. The country rock at this place is a black and reddish-grey gneiss much broken up by intrusive granite masses. At the mine dikes of very dark pyroxenic rock occur in which the mica, which is also very dark coloured, is found. Some of the crystals are of good size, but are much affected by cracks, so that the output of good mica is very small. Dikes of pegmatite also cut the rocks at this place. Masses of pinkish calcite also occur and in these are scattered crystals of apatite. No work has been done here for some years.

In the northern portion of the township of Litchfield, in rear of Campbell bay, several deposits of similar character are found. These have also been opened to some extent but the mineral is generally of the black variety and apparently not of great value. Good sized perfect crystals are rarely found and but little work has, in so far as can be learned, been done at those places.

In the Geology of Canada, 1863, page 35, a dike of pegmatite is recorded as occuring at Montgomery clearing, about five miles west of Pembroke, in which large crystals of brown and black mica occur, but these are said to be rare. Presumably this place has never been well prospected as nothing has been recorded from this locality since that time.

In the vicinity of the Gatineau mica mines have been opened . long the post road about one mile and a half south of the crossing of the Pickanock river with a fair showing of good sized crystals in a mass of pyroxene which cuts the gneiss of the district. This is known as Moore's mine. Farther south a deposit of dark mica was opened several years ago on lot 6, range A., Wright, now the property of the General Electric Co. of Schenectady, N.Y., by Mr. Watters; and on the east side of the river on lot 3, range A., Northfield, several pits have been sunk on pyroxene dikes cutting greyish gneiss, by a Toronto company. Also on lot 13, range B, same township, an opening has been made. With the exception of the Watters property no work has been done at these mines for several years.

Near the line of the Gatineau Valley railway on lot 36, range XII, Low township, in a pegmatite dike which cuts grey gneiss and crystalline limestone, some good crystals of nearly white mica were obtained several years ago in what is known as the Brock mine. This is about half a mile north of Venosta station.

On the east side of the Gatineau in the township of Hincks, lot 22, range II, about two miles from the river, a deposit of dark mica occurring in large crystals was found in connexion with pyroxenic dikes which cut the crystalline limestone. This is known as the Quinn mine. It was operated some years ago by Messrs. Powell and Clemow of Ottawa, by whom nearly two hundred tons of dark mica were extracted and shipped to Ottawa. Work has been suspended at this place for several years.

In the township of Alleyn near Kazabazua river on lot 10, range II, a large deposit of excellent mica has been worked by Mr. Joshua Ellard, of Wright post-office. The country rock is a grey gneiss with limestone, cut by pyroxene dikes, the mica occurring in a band several feet thick, with calcite. [illegible] crystals are of good size and quality, amber yellow, and several hundred tons have been extracted.

On lot 12, range I, on land of John Gibson, several openings have been made. The work was carried on by Mr. E. Haycock in 1898, the mica occurring in pyroxene with calcite and was of good quality, some of the crystals being of large size. Not recently worked.

On lot 4, range II, on land of Mrs. Mullingham, mica occurs in pyroxene with a little apatite and calcite, the enclosing rock being a hard red granite. Some crystals of large size and good quality were obtained. This place was operated at intervals, in 1898–1900, but the amount obtained, though considerable, has not been reported.

In the township of Cawood, on lots 23–24, range III, some good crystals of nearly white mica were found in 1897, and the mine was worked for a short time in the following year by Dr. Duhamel of Hull.

On lot 41, range V, amber mica of good quality was extracted to a small extent in 1898. This locality is said to be about twenty miles north of Shawville on the Pontiac and Pacific railway (C. P. R.). Prospecting has also been carried on to some extent on lots 41 and 43, range IV, and on lots 40, 42, 44, 45, 46, range V.

On lot 12, range VI, is the Prestly mine, the mica occurring in an irregular vein of pyroxene with some calcite, cutting a grey granite A small amount of work was done here, but the property has apparently been abandoned for the present.

On lot 18, range VI, the Brock and Pritchard mine was worked at intervals in 1898-99. The country rock is largely a reddish granite-gneiss, cut by dikes of pyroxene carrying some calcite. It is situated on the bank of the Kazabazua river, and some large crystals of good quality were obtained, but work has been suspended for several years

Indications of mica are reported from lots 17 and 22, range VII, Low township, and from lot 53, range VIII, Aldfield. Also from lot 14, range I, Clarendon, and from lot 51, range III, Thorne. From the last place several tons were taken.

In the township of Litchfield black mica was found on lots 22–23, range IX, on lot 20, range XI, and in Waltham, on lots 7–8, range A, but the quantity apparently is small in all these localities. The mica from the western areas is for the most part of the black variety.

### *Asbestus.*

The asbestus found in the crystalline rocks of this area is all chrysotile. The principal place where it has been mined is at the Pogan fall near the Gatineau river in the township of Denholm, where operations have been carried on irregularly for more than ten years. The veins are small and the rock is shipped probably for the manufacture of non-conducting cement since the fibre is not sufficiently long for good spinning as compared with that from the Thetford mines.

Small deposits of similar mineral are found near the Pickanock river in the township of Wright, but no attempt at mining has been made at this place. It is also found in serpentinized limestone or pyroxenite near the village of Bryson on the Ottawa river. At none of these places is the quantity sufficient apparently for profitable mining.

### *Gold.*

Attempts to mine gold have been made at a point on the road leading west from Old Pontiac village on the Ottawa at the foot of the Chats falls to Bristol mines. The location is on an irregular body of good looking quartz which is close to the line of the old horse railway past the falls. A shaft was sunk to a depth of about 100 feet, the quartz being followed down for about half this depth when it was apparently cut off by a granite mass. The rocks in the vicinity are schists and limestones cut by red granite. No information as to the gold contents of the quartz is to hand, and work was abandoned in 1899. The rocks belong to the Hastings or Grenville series.

### *Building Stones.*

The limestones of the Trenton, Black River and Chazy formation yield a fine quality of building stone. Large quarries are located at several points, notably on the Black River outcrops south of the entrance of Buckham bay on the Ottawa river in the township of Torbolton; on similar strata to the south of Sand Point; in the Black River outlier on the south side of the Muskrat river, in the townships of Westmeath and Stafford, and also at Seche point, on the Ottawa, above Coulonge village.

In the crystalline limestones, also, several important quarries are located. Of these that near the village of Portage du Fort has yielded some excellent marble for columns and blocks which have been employed in the Parliament buildings at Ottawa. A very beautiful marble is also found at the village of Bryson. In the township of Ross on lot 19, range VI, a ledge of white crystalline dolomite has been worked to some extent locally and yields a very handsome white stone. The marbles of Arnprior are in similar rocks but here the limestone is variegated with dark bands and cloudings. The rock at Renfrew is somewhat similar and has been worked for building stone and for lime burning for some years.

Some of the massive red granites should furnish an excellent material for constructive purposes. It has not yet been utilized to any extent. A large quarry alongside the line of Gatineau Valley railway, about one mile south of Wakefield station, has been opened in a dark coloured granitic rock for road metal, by the Ottawa city corporation. The rock appears to be well adapted for this purpose.

### *Molybdenite.*

A deposit of this mineral has been worked irregularly for some years at a point about a fourth of a mile south of Healy station on the Canadian Pacific railway. The mineral occurs at the contact of granite with the gneiss, but is in limited quantity. Other small deposits of this mineral are reported as occurring on Calumet island and in the township of Cawood, and in the eastern part of Oldfield, but in so far as yet ascertained the mineral is not in sufficent quantity to be profitably mined, though good specimens can be obtained.

### *Brick clays.*

Brick clays are found at many points throughout the Ottawa basin Brick yards are numerous, and tile works are carried on at several points. One of these is near Kilmaurs post office in Torbolton township, and another near Loch Winnock in the township of McNab. The brick yards are used almost entirely for local demand.

### *Ochre.*

A deposit of ochre is found on lot 7, range III, of Onslow, about one mile west of Quio village. It it owned by Mr. David Ross of that place and has been locally used for some years as a paint. It appears to be quite extensive and of a quality well suited for this purpose.

### *Shell-Marl.*

Deposits of fresh-water marl are found at a number of points in the area south of the Ottawa river. Among the principal of these within the limit of the map-sheet may be mentioned the following

Mink lake in the township of Wilberforce, about three miles distant from the Eganville branch of the Canadian Pacific railway between Douglas and Eganville. The area of the lake is over 1,000 acres and the marl extends over a large portion of the bottom, showing along the shores, especially on the south side. The depth of the deposit is in places over nine feet, the water is for the most part shallow and the lake can be drained readily by deepening the discharge at the east end.

In the township of Ross several of the lakes which form a long narrow chain extending southeast from Muskrat lake near Cobden into the township of Horton contain marl in their basins. Among the most important of these deposits yet known is that in Green lake on lot 13, range II, where the material is found along the edges with an area of over five acres in one place and a depth of five to twelve feet. Also on the southeast side of the lake over a space of ten acres with about the same thickness.

On a small lake in the vicinity on lot 15, range II, marl is found banked up near the outlet for 200 yards with a depth of four to five feet, and probably underlies the bed of the lake.

In Westmeath marl is reported as occurring in a lake-bottom on lots 9 and 10, east front range B., but the extent of the deposit has not been determined; as also in several small lakes on Calumet island where also the extent is unknown but probably not very large.

# APPENDIX

## Preliminary lists of organic remains from the Chazy, Black River, Trenton, and Pleistocene formations comprised within the area of the Pembroke sheet (No. 122).

BY

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## INTRODUCTION.

Of the geological formations which usually characterise the succession of Palæozoic strata in the Ottawa valley, there appear to be represented within the area of the Pembroke sheet, so far as palæontological collections afford evidence, only the Chazy, Black River and Trenton formations. Through the writings of Sir William Logan, J. W. Salter, Alexander Murray, E. Billings, J. F. Whiteaves and others, much work has already been done in describing and illustrating organic remains obtained from within the area of this sheet. There are few localities in Canada where a more interesting collection of palæozoic fossils can be made than at Paquette rapids, on the Ottawa river, near Westmeath P. O. Not only are they well-preserved, but abundant, and consequently they will always prove important to the geologist.

### THE CHAZY FORMATION.

The only locality from which collections of Chazy age were obtained within the area of the Pembroke sheet was on Allumette island, and characterized by the presence of *Lingula lyelli*, Billings.

### THE BLACK RIVER FORMATION.

The best collections from within the area examined comprise those from the Black River formation. Not only are the remains abundant, but as a rule in such excellent state of preservation that their leading characters may readily be detected, though, at times, the more complete silicification of the hard parts preserved leads to obliteration of some of the characters that ought to be expected. The original collections made by Sir Willian Logan, from the "eastern end of Allumette island" and those made by Messrs. Richardson, Murray, Weston, and the writer, as well as others from Paquette rapids, were no doubt practically from one and the same place. This is *par excellence* one of the finest localities where fossils of Black River age can be obtained to advantage

### THE TRENTON FORMATION.

At Eganville rapids there is one outcrop of the Trenton limestone, and several of the localities from which collections were made appear to show outcrops of limestone with fossils approximating the Trenton formation in age. Amongst them are those of the Bonnechère valley, from which Billings listed not less than sixteen species—yet a number of the forms referred to the Trenton, are not uncommonly referred to the Black river also.

Following is a brief historical sketch of the palæontological work already accomplished. This, in turn, is followed by a few lists of such organic remains as have been collected from different localities within the limits of the Pembroke sheet, not previously recorded. Such lists are intended to serve as faunal lists merely.

### HISTORICAL SUMMARY.

In his report for 1845-46 Sir William Logan records [1] the following species at the several localities given. I. Romain clearing; Corals, and *Leptaena deltoidea*. II. Pointe Sèche; *Isotelus*, *Calymene*; Univalve and bivalve shells, orthoceratites, encrinites, and corals "replaced by silex." III. Romain point; encrinites, bivalve and univalve shells, &c., as in II and IV Paquette rapids. Many of the species found in II and III, also one *Orthoceras*, "five feet long". V. Allumette falls. *Fucoids*. VI. Head of the Fourth chute of the Bonnechère river; *Isotelus*, *Calymene*, *Orbicula*, *Strophomena*, *Orthis*, *Delthyris*, *Atrypa*, *Nuculites*, *Pleurotomaria*, *Trochus*, *Bellerophon*, *Orthoceras*. VII. Becket island; *Lingula*.

In 1846, Logan [2] points out that marine testacea of the Pleistocene period were found at Pakenham and Fitzroy.

In 1851, Salter [3] identified the following species from the limestones of the "Southeastern end of Allumette island, on the Ottawa river":

*Stromatocerium rugosum*.
*Columnaria alveolata*.
*Maclurea*, sp.
*Scalites*, n. sp.
*Murchisonia ventricosa*.
*Murchisonia bicincta*.
*Murchisonia gracilis*.
*Murchisonia bellicincta*.
*Turitella*-like form.
*Euomphalus*, more than one form with "smooth shells."
*Turbines*, or allied shells.
*Holopea*, one or two species, one closely allied to *H. bilix* of the Western States.

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[1] Rep. Prog. Geol. Surv. Can. for 1845-46, pp. 64-67, 1846.
[2] Rep. Prog. Geol. Surv. Can. for 1845-46, p. 71, 1846.
[3] Trans. Sect. Brit. Assoc. Adv. Sc. 1851 (Ipswich meeting) pp. 63-64.

*Scalites*, three species. (1) a small species, commonly encrusted over ; (2) A muricated form with spines like a *Delphinula* ; (3) *Euomphalus uniangulatus*."

*Raphistoma*, "two or three species of this genus " which appears to be only a discoid form of *Scalites*.

*Turritella* (?) A "spirally ribbed " species.

*Maclurea*, most abundant and characteristic shell.

*Ctenodonta*, a new genus founded so as to receive two species "resembling *Nucula* in every general character," but which "differed from it importantly by having no internal liga-"ment, but a very manifest exterior one."

*Lyrodesma*, sp.

*Orthis tricenaria*, Conrad. Very abundant.

*Leptæna filitexta*, Hall. Very abundant.

*Atrypa increbescens*, Hall.

*Orthis*, two or three species.

Terebratulæ, some small forms.

*Bellerophon* (*Bucania*) *sulcatina*, Emmons

*Bellerophon*, sp., cf. *B. oblectus*, Phillips.

*Cleodora*. cf. *Atrypa transversa*, Portlock.

*Turbo trochleatus*.

*Turbo tritorquatus*, McCoy.

*Gonioceras anceps*, Hall.

*Cyrtoceras annulatum*.

*Cyrtoceras lamellosum*.

*Orthoceras arcuoliratum*, Hall.

*Orthoceras bilineatum*, Hall.

*Orthoceras laqueatum*, Hall.

*Ormoceras*, sp., "in all probability O. *tenuifilum*, Hall.

*Schizocrinus nodosus*, Hall.

*Streptelasma*, one or two species.

*Favosites lycoperdon*, "branched varities."

*Receptaculites* "not identical with R. *Neptuni* of Europe.

*Asaphus* (*Isotelus*) *gigas*, Hall.

In 1852, Logan records[1] phosphatic matters, supposed bones and coprolites found at Lac des Allumettes, in sandstone, associated with remains of *Lingulæ*.

In 1852, Dr. T. Sterry Hunt[2] gives the result of chemical analyses of certain fossil organic remains from Sir William Logan's collections of 1845 at Lac des Allumettes. *Lingula* and *Pleurotomaria* or *Holopea* occur in coarse siliceous sandstone."

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[1] Proc. Geol. Soc. London, vol. VIII, No. 31, p. 209, Aug. 1, 1852.

[2] Rep. Progr. Geol. Surv. Can. for 1851-52, pp. 109-110. Quebec, 1852.

In his report for the year following (1853) Dr. Hunt points out additional results from an examination made of the shells referred to in the preceding paragraph.

In 1856, Billings incidentally records the occurrence of *Murchisonia gracilis* from (a) Paquette rapid, (b) the township of Westmeath; (c) the third chute of the Bonnechère, in the county of Renfrew.

In 1856, Billings records the presence of *Strophomena filitexta* at (1) the Fourth chute on the Bonnechère in the county of Renfrew; (2) the lower end of Allumette island opposite the township of Westmeath in the same [illegible].

In 1856, Billings [illegible] *Orthoceras constrictum*, Hall, is abundant in the lower part of the Trenton limestone at Paquette rapids, in the beds reposing directly on the Black River limestone.

### PLEISTOCENE.

Mr. Billings,[4] under the sub-head "The Lawrencian formation" records *Mallotus villosus*, Cuvier, from the clays of Flat rapids, Madawaska river, county of Renfrew.

In 1857,[5] records five additional species from Paquette rapids, the lower end of Allumette island, the Fourth chute of the Bonnechère river and Fitzroy township as follows:—(1) *Glyptocrinus priscus*; (2) *Cyrtoceras falx*; (3) *C. regulare*; (4) *Orthoceras allumettense*; (5) *O. hastatum*.

In 1857, Murray[6] ascribed the age of the fossiliferous rocks of the southwest corner of the township of Bromley, on the evidence afforded by the organic remains, to the Black River and Trenton formations. No lists are given.

In 1857, Murray[7] cites the occurrence of *Cythere* beyond the dislocation, in the top beds, at the Fourth chute of the Bonnechère. He assigns the age of the strata examined to the different formations from the Calciferous to the Trenton. At the Falls, *orthoceratites* and tur-

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[1] Can. Nat. and Geol. Vol. 1. No. 1, chap. IV, p. 42, Ottawa, Feb. 1856

[2] Can. Nat. and Geol. Vol. 1, No. 111, Chapt. XXXIII, p. 203, June 1856, Montreal, Que.

[3] Can. Nat. and Geol. Vol. 1, No. IV, pp. 312-320, Ottawa, 1856.

[4] Can. Nat. and Geol. Vol. 1, No. V. Chapt. XVII, p. 345, Dec. 1856, Ottawa.

[5] Rep. Progr. Geol. Surv. Can. for 1853 54-55-56, pp. 256-345, Toronto.

[6] Rep. Progr. Geol. Surv. Can. for 1853, p. 96, 1857, Toronto.

[7] Rep. Progr. Geol. Surv. Can. 1853-54--55-56, p. 95, Toronto, 1857.

binate shells, &c., occur in the Chazy, Black River and Trenton formations constituting the first outlier. In the second outlier, *Columnaria alveolata*, *Cythere*, *orthoceratites*, *Atrypa*, *Leptæna*, corals, &c., are recorded. In the third outlier, the *Chazy* formation affords *Scolithus linearis*, which outlier continues from the foot of Jessup rapids about three miles above the Fourth chute of the Bonnechère to the Eganville rapids, *Leptæna sericea*, *Chætetes lycoperdon* and *Lingula* were abundant with other fossils of the Trenton formation.

In 1858, Billings [1] records the following species of fresh water shells found forming the shell-marl: *Physaheterostropha*, *Planorbis campanulatus*, *P. bicarinatus*, *Paludina decisa*, *Cyclas orbicularis*, *Unio complanatus*, *Anodonta fluviatilis*.

In 1858, Billings [2] lists the fossils from the Bonnechère valley, as follows:

From the Chazy.
*Raphistoma staminea*, Hall.
*Illænus arcturus*, Hall.

From the Birdseye.
*Murchisonia perangulata*, Hall.

From the Black river.
*Columnaria alveolata* (Goldfuss).
*Stromatocerium rugosum* (Hall).
*Orthoceras multitubulatum* (Hall).
*Orthoceras tenuifilum* (Hall).

From the Trenton formation.
*Monticulipora dendrosa* (Billings).
*Orthis insculpta* (Hall).
*Orthis tricenaria* (Conrad).
*Strophomena alternata*, (Conrad).
*Rhynchonella increbescens*, (Hall).
*Rhynchonella bisulcata* (Emmons).
*Pleurotomaria subconica* (Hall).
*Pleurotomaria umbilicata* (Hall).
*Murchisonia gracilis* (Hall).
*Murchisonia bicincta* (Hall).
*Murchisonia ventricosa* (Hall).
*Subulites elongatus*, Emmons (Hall).
*Orthoceras bilineatum* (Hall).

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[1] Rep. Progr. Geol. Surv. Can 1857. p. 149, Toronto, 1858.

[2] Rep. Progr. Geol. Surv. Can. for 1857, pp. 153 and 153, Toronto, 1858.

14. *Phacops callicephalus* (Hall).
15. *Cheirurus pleurexanthemus* (Green).
16. *Acidaspis ? spiniger* (Hall).

Seven additional species are given, but no geological horizon assigned to them, namely:—

1. *Glyptocrinus priscus.* (2) Columns of *Thysanocrinus*, sp. (3) *T. pyriformis.* (4) *Orthis gibbosa ?* (Billings). (5) *Eichwaldia subtrigonalis* (Billings). (6) *Vanuxemia inconstans*, (Billings). (7) *Cyrtodonta canadensis* (Billings).

Then follows a list of seventy-five species found in the beds which hold characteristic Black River fossils "all new forms not known to occur in the Trenton, and all species not clearly identified being excluded."

*Tetradium cellulosum ?* (Hall).
*Columnaria alveolata* (Goldfuss), probably *C. Halli, Nicholson.*
*Monticulipora dendrosa* (Billings).
*Petraia profunda* (Hall).
*Petraia corniculum* (Hall sp.).
*Receptaculites occidentalis* (Salter).
*Stromatocerium rugosum* (Hall).
*Glyptocrinus priscus* (Billings).
*Strophomena alternata* (Conrad).
*Strophomena filitexta* (Hall).
*Leptæna sericea* (Sowerby).
*Orthis testudinaria* (Dalman).
*Orthis gibbosa* (Billings).
*Orthis insculpta* (Hall).
*Orthis tricenaria* (Conrad).
*Rhynchonella increbescens* (Hall).
*Rhynchonella recurvirostra* (Hall).
*Rhynchonella bisulcata* (Emmons).
*Ctenodonta levata* (Hall).
*Ctenodonta nasuta* (Hall).
*Ctenodonta gibbosa* (Hall).
*Ctenodonta dubia* (Hall).
*Euomphalus uniangulatus* (Hall).

(Note: This is the characteristic species of the Beekmantown ("Calciferous") formation, and is usually designated as *Ophileta compacta*, Salter, or as *Ophileta complanata*, Vanuxem, the three names being synonymous.

*Raphistoma staminea* (Hall).
*Maclurea logani* (Salter).
*Pleurotomaria lenticularis* (Hall).
*Pleurotomaria rotuloides* (Hall).
*Pleurotomaria umbilicata* (Hall).
*Pleurotomaria subconica* (Hall).
*Murchisonia bicincta* (Hall).
*Murchisonia tricarinata* (Hall).
*Murchisonia ventricosa* (Hall).
*Murchisonia perangulata*, (Hall).
*Murchisonia bellicincta*, (Hall).
*Murchisonia gracilis*,( Hall).
*Murchisonia subfusiformis*, (Hall).
*Subulites elongatus*, (Emmons).
*Bellerophon sulcatinus*, (Emmons).
*Bellerophon rotundatus*, (Hall).
*Bellerophon bilobatus*, (Sowerby).
*Bellerophon expansus*, (Hall).
*Bellerophon bidorsatus*, (Hall).
*Bellerophon punctifrons*, (Emmons).
*Cyrtolites compressus*, (Conrad, sp.).
*Orthoceras* (*Ormoceras*) *tenuifilum*, (Hall).
*Orthoceras multicameratum*, (Emmons).
*Orthoceras recticameratum*, (Hall).
*Orthoceras fusiforme*, (Hall).
*Orthoceras arcuoliratum*, (Hall).
*Orthoceras bilineatum*, (Hall).
*Orthoceras anellum*, (Conrad).
*Orthoceras amplicameratum*, (Hall).
*Orthoceras strigatum*, (Hall).
*Orthoceras laqueatum*, (Hall).
*Orthoceras allumettense*, (Billings).
*Orthoceras ottawaënse*, (Billings).
*Orthoceras hastatum*, (Billings).
*Orthoceras decrescens*, (Billings.
*Orthoceras huronense*, (Billings).
*Gonioceras anceps*, (Hall).
*Orthoceras subcentrale*, (Hall).
*Orthoceras longissimum*, (Hall).
*Orthoceras multitubulatum*, (Hall).
*Orthoceras annulatum*, (Hall).
*Oncoceras constrictum*, (Hall).

*Cyrtoceras annulatum*, (Hall).
*Cyrtoceras macrostomum*, (Hall).
*Cyrtoceras multicameratum*, (Hall).
*Lituites undatus*, (Emmons).
*Asaphus extans*, (Hall).
*Illænus arcturus*, (Hall).
*Ceraurus pleurexanthemus*, (Green)
*Phacops callicephalus*, (Hall).
*Illænus ovatus*, (Conrad).
*Acidaspis ? spiniger*, (Hall).

In 1858, Billings [1] published three papers or reports in which he described and illustrated several species from within the area of this sheet. These are as follows :—

A. From Paquette rapids. (1) *Cyrtodonta rugosa* ; (2) *C. canadensis* ; (3) *C. spinifera* ; (4) *C. obtusa* ; (5) *C. sub-truncata*, (Hall sp.) ; (6) *C. subangulata*, (Hall sp.; (7) *Obolus canadensis* ; *Eichwaldia subtrigonalis*.

B. From the Fourth chute of the Bonnechère. (1) *Cyrtodonta rugosa* ; (2) *C. canadensis* ; (3) *C. spinifera* ; (4) *C. obtusa* ; (5) *C. subtruncata*, (Hall) ; (6) *Vanuxemia inconstans* ; (7) *Obolus canadensis* (8) *Eichwaldia subtrigonalis*.

C. From the township of Stafford, county of Renfrew. (1) *Obolus canadensis*.

D. From the township of Westmeath, county of Renfrew. (1) *Obolus canadensis*.

### BONNECHÈRE RIVER VALLEY.

Of Chazy fossils from the Fourth chute of the Bonnechère river, near C. Merrick's mill, where Alex. Murray measured the section published in his report for 1854, pp. 96 and 97, Mr. E. Billings records [2] the following :—

*Bryozoa.*

*Stictopora fenestrata* (Hall) or a form closely allied thereto.

*Gasteropoda.*

*Raphistoma staminea* (Hall).

*Trilobita.*

*Illænus arcturus* (Hall).

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[1] Rep. Progr. Geol. Surv. Can. for 1857, Toronto, 1858.
Can. Foss. Descript. N. gen. and sp. Sil. and Dev. Canada, Montreal 1858.
Can. Nat. and Geol. Vol. III, No. 6, Art. XXXIV, pp. 419-443, Montreal, 1858.

[2] Rep. Progr. Geol. Surv. Can. for 1857, pp. 154-155, Montreal, 1858.

In 1858 [1] Salter described and figured a large number of species from Logan's collection.

There are as follows :

*Maclurea logani.*
*Raphistoma lapicida.*
*Raphistoma aperta.*
*Helicotoma planulata.*
*Helicotoma planulata*, var *muricata.*
*Helicotoma spinosa.*
*Helicotoma larvata.*
*Murchisonia bicincta.*
*Murchisonia serrata.*
*Murchisonia helicteres.*
*Murchisonia (Hormotoma) gracilis*, (Hall).
*Murchisonia (Hormotoma) ventricosa*, (Hall).
*Cyclonema halliana.*
*Cyclonema semicarinata.*
*Trochonema umbilicata*, (Hall).
*Eunema strigillata.*
*Eunema ? pagoda.*
*Eunema cerithioides.*
*Loxonema murrayana.*
*Cyrtoceras falx*, (Billings).
*Cyrtoceras billingsii.*
*Ctenodonta nasuta*, (Hall).
*Ctenodonta logani.*
*Ctenodonta contracta.*
*Ctenodonta gibberula.*
*Ctenodonta astartæformis.*
*Receptaculites occidentalis.*

Besides the above, Salter records other forms from the same collection, as follows :—

*Bellerophon sulcatinus, B. rotundatus, Stromatocerium rugosum, Columnaria alveolata, Gonioceras anceps, Strophomena filitexta, Pentamerus (Atrypa) hemiplicatus, Atrypa increbescens, Cyrtoceras annulatum, C. lamellosum, Orthoceras arcuoliratum, O. bilineatum, O. laqueatum, Ormoceras tenuifilum, Schizocrinus nodosus, Petraia (Streptelasma)*, sp., *Favosites lycoperdon, Asaphus gigas, Murchisonia (Loxonema) sub-*

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[1] Dec. 1. Figs. and descript. Can. Org. Rem., Geol. Surv. Can. 1858.

*fusiformis, Lyrodesma, n. sp., Strophomena planumbona, Holopea obliqua, and Glyptocystites, sp.*

In 1858, Prof. T. Rupert Jones, F.R.S. [1] describes, records and illustrates the following Ostracoda from Paquette rapids:—(1) *Leperditia canadensis*, Jones, var. *Paquettiana*, n. var. (2) *Cytheropsis concinna*, Jones. (3) *C. siliqua*, Jones. (4) *C. rugosa*, Jones.

In 1859, Billings [2] records describes and figures *Lingula lyelli* from the Calciferous sandrock of Allumette island, but later, [3] in discussing fossils from the Chazy limestones removes this species from the Calciferous sandrock and places it in the Chazy formation, and besides *Lingula lyelli*, records also *Strophomena incrassata*, Hall, from the Fourth chute of the Bonnechère, and *Orthoceras allumettense* from Paquette rapids, and *Bathyurus angelini* is recorded from the Chazy limestone of Fitzroy Harbour.

In 1860, Billings [4] described and figured the following species, all from Paquette rapids. (1) *Straparollus circe*, (2) *S. Eurydice*; (3) *S. asperostriatus*: (4) *Bellerophon argo*: (5) *B. Charon*; (6) *Phragmoceras primævum*; (7) *Orthoceras tener*; (8) *O. pertinax.*

From 1861-1865, Billings [5] described, and figured a number of species from within the area of the Pembroke sheet, as follows:—

(1) *Holopea pyrene*; (2) *H. nereis*; (3) *Pleurotomaria arachne*; (4) *Murchisonia procris*; (5) *Eunema cerithioides*; (6) *Subulites parvulus*; (7) *Metoptoma erato*; (8) *Conocardium immaturum*; (9) *Modiolopsis nais*; (10) *Ctenodonta abrupta*; (11) *Cyrtodonta leucothea*; (12) *Petraia aperta*: (13) *Porambonites ottawaënsis*; (14) *Pleurotomaria dryope*; (15) *P. Vitruvia*; (16) *Murchisonia alexandra*: (17) *Metoptoma superba*; (18) *Cyrtocerina typica*; (19) *Chiton canadensis.*

In his admirable compendium of the geology of Upper and Lower Canada, Sir W. E. Logan, [6] records with Mr. E. Billings the following species at Allumette rapids:—(1) *Lingula lyelli*; (2) *Pleurotomaria* or *Holopea*; and ascribes them to the Chazy formation.

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[1] Figs. and Descrip. Can. Org. Rem. Dec. 3. Montreal, 1858.
[2] Can. Nat. and Geol. Vol. IV. No. 5. Art. XXVIII, p. 348, Montreal, 1859.
[3] 2 ibid. Art. XXIV, No. 6. Dec. 1859, p. 426, Montreal, 1859.
[4] Can. Nat. and Geol. Vol. V, No. 3, June, 1860. Montreal.
[5] Palæozoic Fossils, Vol. 1, 1861-1860, Montreal.
[6] "Geology of Canada" 1863. p. 125, Montreal.

In 1883,[1] **Arthur H. Foord, F.G.S.,** records two species of organic remains from the strata of Paquette rapids, Ottawa river, as follows :—

*Monotrypella aéqualis*, Ulrich, p. 15.

1882. Ulrich, E.O., Journ. Cincinnati Soc. Nat.
Hist., Vol. V, p. 247, pl. 2,
figs. 3, 3a, 3b, 1882.

Locality, formation and collector :—Paquette rapids on the Ottawa river ; Black River formation ; James Richardson.

*Batostoma Ottawaënse*, Foord. p. 18, pl. 2, figs. 1-1f.

Locality, formation and collector :—Paquette rapids ; James Richardson ; Black River.

In 1888, Dr. Arthur H. Foord, F.G.S., formerly Assistant-Palæontologist to the Geological Survey of Canada, recorded[2] the occurrence of Canadian species of Cephalopoda in the collections of the British Museum. These are as follows :—

*Orthoceras arcuoliratum*, Hall.
*Cyrtoceras falx*, Billings.

Both species are stated to have come from Allumette island, Ottawa river, Canada.

In 1896, the writer presented a paper to[3] the Royal Society of Canada bearing on the faunas characterizing the geological formations and outliers of the Ottawa Palæozoic Basin. This paper was intended as an appendix or supplement to one presented by Dr. R.W. Ells before the same society, entitled :—"Palæozoic outliers in the Ottawa basin."

The writer listed some sixty-two of the most characteristic species of fossils from the Black River formation of Paquette rapids, from within the area comprised in the Pembroke sheet.

The sixty-two species therein listed were all taken from the collections made by officers of the Geological Survey of Canada, and their generic as well as specific designations were given in so far as more recent changes in nomenclature and classification seemed to warrant. They included the following :—

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[1] Contrib. Micro—Palæontology of the Cambro-Silurian rocks of Canada, Geol. and Nat. Hist. Surv. of Canada, Ottawa, 1883.

[2] Catal. Fossil Cephalopoda, British Museum. Vol. 1, Pt. 1, p. 10, London, 1888.

[3] "Notes on some of the Fossil Organic Remains comprised in the Geological formations and outliers of the Ottawa Palæozoic Basin" Trans. Roy. Soc. Can. Vol. II. New Series) Sect. IV, pp. 151-158, 1896.

PAQUETTE RAPIDS FOSSILS, ALLUMETTE ISLAND OUTLIER.

*Receptaculites occidentalis*, Salter.
*Stromatocerium rugosum*, Hall.
*Tetradium fibratum*, Safford.
*Calapœcia canadensis*, Billings.
*Columnaria halli*, Nicholson.
*Streptelasma profundum*, Hall.
*Petraia aperta*, Billings.
*Porambonites ottawaënsis*, Billings.
*Solenopora compacta*, v. *Paquettiana*, Ami.
*Eichwaldia subtrigonalis*, Billings.
*Camarella volborthi*, Billings.
*Camarella panderi*, Billings.
*Dinobolus magnificus*, Billings.
*Modiolopsis nais*, Billings.
*Ctenodonta astartæformis*, Billings.
*Ctenodonta gibberula*, Salter.
*Ctenodonta logani*, Salter.
*Conocardium immaturum*, Billings.
*Cyrtodonta spinifera*, Billings.
*Cyrtodonta leucothea*, Billings.
*Loxonema murrayanum*, Salter.
*Straparollina asperostriata*, Billings.
*Straparollina circe*, Billings.
*Straparollina eurydice*, Billings.
*Holopea nereis*, Billings.
*Holopea pyrene*, Billings.
*Cyclonema hallianum*, Salter.
*Eunema cerithioides*, Salter.
*Eunema strigillatum*, Salter.
*Eotomaria pagoda*, Salter.
*Eotomaria dryope*, Billings.
*Helicotoma planulata*, Salter.
*Helicotoma larvata*, Salter.
*Raphistoma lapicidum*, Salter.
*Raphistoma apertum*, Salter.
*Liospira vitruvia*, Billings.
*Plethospira ? arachne*, Billings.
*Omospira alexandra*, Billings.
*Lophospira helicteres*,, Salter.
*Lophospira perangulata*, Hall.
*Lophospira serrulata*, Salter.

*Chiton canadensis*, Billings.
*Metoptoma erato*, Billings.
*Scenella superba*, Billings.
*Bellerophon charon*, Billings.
*Oxydiscus argo*, Billings.
*Maclurea logani*, Salter.
*Actinoceras allumettense*, Billings.
*Actinoceras bigsbyi*, Bronn.
*Orthoceras bilineatum*, Hall.
*Orthoceras laqueatum*, Hall.
*Orthoceras strigatum*, Hall.
*Orthoceras arcuoliratum*, Hall.
*Orthoceras hastatum*, Billings.
*Orthoceras tenerum*, Billings.
*Oncoceras constrictum*, Hall.
*Cyrtoceras billingsi*, Salter.
*Cyrtoceras falx*, Billings.
*Cyrtoceras regulare*, Billings.
*Cyrtocerina typica*, Billings.
*Gonioceras anceps*, Hall.
*Cytheropsis siliqua*, Jones.
*Leperditia canadensis*, v. *Paquettiana*, Jones.

In 1897, Prof. E. O. Ulrich [1] described the Lower Silurian Lamellibranchiata, Ostracoda and Gasteropoda of Minnesota. In the course of his remarks on the various genera and species characterizing those strata which are contemporaneous or homotaxial with those of the Ottawa Palæozoic basin, and of the area of the Pembroke sheet in particular, he mentions several species from Paquette rapids and Allumette island, giving descriptions of two new species and one new variety from within the area in question. The following are the species from Paquette rapids :—

*Ctenodonta nasuta*, (N. var.)
*Oxydiscus argo*, Billings, sp.
*Scenella superba*, Billings, sp.
*Raphistoma lapicida*, Salter.
*Omospira alexandra*, Billings.
*Lophospira serrulata*, Salter.
*Lophospira helicteres*, Salter.
*Lophospira perangulata*, Hall.
*Liospira (?) mundula*, Ulrich. (N. sp.)

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[1] The Geol. of Minnesota, Vol. III, Final Report, Palæontology. Minneapolis, 1897.

*Hormotoma salteri*, Ulrich, (N. sp.)
*Solenospira pagoda*, Salter, sp.
*Helicotoma planulata*, Salter.
*Gyronema semicarinatum*, Salter, sp.

Dr. Whiteaves [1] describes and records for the first time from the Black River limestone of Paquette rapids, *Nanno aulema*, Clarke.

In 1900, Lambe, [2] records the species *Tetradium fibratum*, Safford, from Paquette rapids; and in the following year [3] the same author discusses the following corals from Paquette rapids: *Columnaria halli*, Nicholson, *Petraia profunda*, Hall, *P. aperta*, Billings, and *Streptelasma corniculum*, Hall.

*Determinations of fossils from Paquette rapids, Ottawa river, collected by Mr. Weston, of the Geological Survey of Canada.*

In the years 1872 and 1880, Mr. T. C. Weston, F.G.S.A., then a member of the Geological Survey staff, visited Paquette rapids, Ottawa river, and his excellent collections contain the following species determined by the writer.

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[1] Ottawa Naturalist, Vol. XII, No. 6, p. 116, Sept. 1898, Ottawa.
[2] Contrib. Can. Pal. Vol. IV. pt. I. p. 93. Ottawa, 1899-1900.
[3] 2. ibid, Pt. II. Ottawa, 1901.

| Genera and Species. | Author. | 1872. | 1880. |
|---|---|---|---|
| ***PROTOZOA.*** | | | |
| *Receptaculites occidentalis* | Salter. | • | • |
| ***HYDROZOA.*** | | | |
| *Stromatocerium rugosum* | Hall. | • | • |
| ***ZOOPHYTA.*** | | | |
| *Columnaria halli* | Nicholson | | • |
| *Streptelasma profundum* | Hall. | | • |
| *Petraia aperta* | Billings | • | |
| Tabulate coral indt | | • | |
| ***CRINOIDEA.*** | | | |
| Crinoidal fragments | | • | |
| ***MONTICULIPOROIDEA.*** | | | |
| Branching forms of *Monticulip roidea*, indt | | • | • |
| ***BRACHIOPODA.*** | | | |
| *Orthis tricenaria* | Conrad | • | |
| *Dalmanella testudinaria* | Dalman | • | • |
| *Strophomena incurvata* | Shepard | | • |
| ***GASTEROPODA.*** | | | |
| *Oxydiscus argo* | Billings | • | |
| *Bellerophon charon* | Billings | | • |
| *Bellerophon*, sp. | | | • |
| *Eunema ? pagoda* | Salter | • | |
| *Eunema cerithioides* | Salter | | • |
| *Eunema strigillatum* | Salter | | • |
| *Helicotoma larvata* | Salter | • | |
| *Murchisonia*, sp | | • | |
| *Maclurea logani* | Salter | • | • |
| ***PELECYPODA.*** | | | |
| *Ctenodonta gibberula* | Salter | | • |
| *Ctenodonta contracta* | Salter | • | |
| *Ctenodonta astartæformis* | Salter | | • |
| *Ctenodonta nasuta* | (Conrad) | • | |
| *Ctenodonta logani* | Salter | • | |
| ***CEPHALOPODA.*** | | | |
| *Orthoceras recticameratum* | Hall | • | |
| *Orthoceras*, sp., cf. *O. vulgatum* | Billings | | • |
| *Actinoceras bigsbyi* | Bronn | • | |
| *Cyrtoceras*, sp., cf. *C. falx* | Billings | • | |

*Determinations of fossils from localities within the area of the Pembroke sheet, collected by Dr. R. W. Ells*

COLLECTION A. Outcrop No. 1, Boom point, western extremity of Pointe Sèche bay, township of Mansfield, county of Pontiac, Quebec, Collector: R. W. Ells, 1899.

### LIST OF SPECIES.

*Stromatocerium rugosum*, Hall.

*Calapœcia canadensis*, Billings.

*Columnaria halli*, Nicholson.

Obscure tabulate coral, genus and species as yet undetermined.

*Monticuliporoidea*, several species requiring micro-sections before they can be identified.

*Strophomena*, sp.

*Orthis tricenaria*, Conrad.

*Cyrtodonta*, sp. too imperfectly preserved to be identified.

? ? *Operculum* of gasteropod, like that of a *Maclurea*.

*Asaphus*, sp. fragments of the cephalon.

*Cheirurus* sp. a form related to *Cheirurus pleurexanthemus*, Green.

### HORIZON.

The association of species in the above collection appears to indicate an horizon near the summit of the Black River formation, of Ordovician age.

COLLECTION B. Outcrop No. 2, Pointe Sèche; lower or eastern extremity of Pointe Sèche bay, township of Mansfield, county of Pontiac, Que. Collector, R. W. Ells, 1899.

### LIST OF SPECIES.

*Receptaculites occidentalis*, Salter.

*Streptelasma profundum*, Hall.

*Solenopora compacta*, Billings.

*Pachydictya*, sp.

*Intricaria reticulata*, Hall. (—*Subretepora reticulata.*)

*Batostoma ottawaense*, Foord, or a closely related form.

*Monticuliporoidea*, several species requiring micro-sections before they can be identified.

*Crania ?* sp.,

*Strophomnena incurvata*, Shepard. (*Streptorhynchus filitextum* of authors.)

*Rafinesquina alternata* (Emmons) Conrad.

*Orthis* (*Dalmanella*) *testudinaria*, Dalman.

*Rhynchotrema inæquivalvis*, Castelnau. (=*Rhynchonella increbescens* of authors.)

*Hyolithes*, sp., too imperfect for identification.

*Euomphalus?* sp. indt.

*Murchisonia* (*Hormotoma*) sp., a form resembling *Murchisonia alexandra*, Billings.

*Maclurea*, sp. too imperfect for identification

*Orthoceras* sp. Only the body chamber of a species of Orthoceratite is preserved and therefore the specimen is too imperfect for specific determination.

*Orthoceras*, sp., related to *O. hastatum*, Billings.

*Bathyurus*, sp. allied to *B. extans*, Hall.

*Asaphus megistos*, Locke, or a very closely related form.

*Illænus* sp. cf. *Illænus Americanus*, Billings.

*Lichas trentonensis*, Hall.

*Primitia logani*, Jones,

*Leperditia canadensis*, Jones.

### HORIZON, &c.

The fossils are preserved in a yellowish-grey weathering, impure, partly crystalline limestone holding crinoidal fragments.

The fauna represented in the foregoing list indicates the presence of strata which can be more properly referred to the upper half of the *Black River formation*; The presence of *Receptaculites occidentalis*, Salter, and *Streptelasma profundum*, Hall, evidently point in that direction. There are a number of forms, including *Rhynchotrema inæquivalvis*, *Dalmanella testudinaria*, *Lichas trentonensis*, and rolled or worn specimens of *Solenopora compacta* which appear to indicate the lower beds of the Trenton formation.

COLLECTION C. Loose blocks of limestone, shores of Pointe Sèche bay, township of Mansfield, county of Pontiac, Quebec.
Collector: R. W. Ells. 1899.

*Crinoidal* fragments.

*Bryozoa*, several genera and species which require micro-sections before they can be identified. *Pachydictya*, *Ptilodictya*, *Stictopora* appear to be present.

*Monticuliporoidæ*, several branching forms which require micro-sections also before they can be accurately determined.

*Strophomena*, sp. a fragment, too imperfectly preserved to be identified.

*Rhynchotrema inæquivalvis*, Castelnau.

*Camarella panderi*, Billings. A well preserved and adult form of this rather rare species.

*Bellerophon* ? ? sp.,

*Lophospira perangulata*, Hall.

*Obscure gasteropod*, probably a species of *Murchisonia*.

*Asaphus*, sp. fragment of the head shield, too imperfect to be determined specifically.

HORIZON, &c.

The above association of species indicates that the blocks of limestone are probably of Black River or Lower Trenton age.

PAQUETTE RAPIDS, OTTAWA RIVER, COLLECTOR: JOHN STEWART. 1887.

Amongst the collections examined by the writer from various localities within the area of the Pembroke sheet, there occurs one, made by Mr. John Stewart, formerly of the Interior Department, Ottawa. It was made in 1887 at the type locality and contains the following species :—

*Palæophyllum*, sp. cf. P. *rugosum*. Nicholson.

*Columnaria*, sp. cf. C. *incerta*, Billings. or undescribed form.

*Cyclonema* or *Lophospira*, too imperfect for identification.

*Holopea nereis*, Billings.

*Eunema pagoda*, Salter. (*Solenospira pagoda*, Salter sp.)

*Pleurotomaria dryope*, Billings.

MUSEUM OF THE GEOLOGICAL SURVEY DEPARTMENT, OTTAWA.

In the Museum cases of the Geological Survey Department at Ottawa there are exhibited a large number of species of fossils which serve to illustrate the palæontological materials which characterize the rock formations of the area comprised in the Pembroke sheet (No. 122). Of these there are those from Paquette rapids, and from the Bonnechère river, which form important series, as follows:—

A.

## FROM PAQUETTE RAPIDS, OTTAWA RIVER.

LIST OF SPECIES.

### PROTISTA.

*Receptaculites occidentalis*, Salter.

### HYDROZOA.

*Stromatocerium rugosum*, Hall.

## ZOOPHYTA.

*Tetradium fibratum*, Safford.
*Calapœcia canadensis*, Billings.
*Columnaria halli*, Nicholson.
*Petraia aperta*, Billings.
*Streptelasma profundum*, Hall.
*Streptelasma corniculum*, Hall.
*Pachydictya acuta*, Hall.

## BRACHIOPODA.

*Obolellina magnifica*, Billings.
*Strophomena incurvata*, Shepard.
*Dalmanella testudinaria*, Dalman.
*Porambonites ottawaënsis*, Billings.
*Rhynchotrema inæquivalvis*, Castelnau. = *Rhynchonella increbescens*, Hall.
*Camarella volborthi*, Billings.
*Eichwaldia subtrigonalis*, Billings.
*Camarella panderi*, Billings.

## PELECYPODA.

*Lyrodesma poststriatum*, Emmons.
*Modiolopsis nais*, Billings.
*Modiolopsis faba*, Conrad.
*Modiolopsis carinata*, Hall.
*Ctenodonta abrupta*, Billings.
*Ctenodonta astartæformis*, Salter.
*Ctenodonta contracta*, Salter.
*Ctenodonta gibberula*, Salter.
*Ctenodonta nasuta*, Conrad.
*Ctenodonta logani*, Salter.
*Cyrtodonta canadensis*, Billings.
*Cyrtodonta spinifera*, Billings.
*Cyrtodonta rugosa*, Billings.
*Cyrtodonta obtusa*, Hall.
*Cyrtodonta leucothea*, Billings.
*Conocardium immaturum*, Billings.

## GASTEROPODA.

*Loxonema murrayanum*, Salter.
*Straparollina asperostriata*, Billings.
*Straparollina circe*, Billings.

*Straparollina eurydice*, Billings.
*Holopea nereis*, Billings.
*Holopea pyrene*, Billings.
*Cyclonema hallianum*, Salter.
*Cyclonema semicarinatum*, Salter.
*Trochonema umbilicatum*, Hall.
*Eunema cerithiodes*, Salter.
*Eunema strigillatum*, Salter.
*Eunema pagoda*, Salter.
*Helicotoma planulata*, Salter.
*Helicotoma spinosa*, Salter.
*Helicotoma larvata*, Salter.
*Raphistoma lapicidum*, Salter.
*Raphistoma apertum*, Salter.
*Pleurotomaria vitruvia*, Billings.
*Pleurotomaria dryope*, Billings.
*Pleurotomaria arachne*, Billings.
*Murchisonia procris*, Billings.
*Murchisonia alexandra*, Billings.
*Murchisonia bellicincta*, Hall.
*Murchisonia gracilis*, Hall.
*Murchisonia perangulata*, Hall.
*Murchisonia milleri*, Hall.
*Murchisonia helicteres*, Salter.
*Murchisonia serrulata*, Salter.
*Murchisonia ventricosa*, Hall.
*Chiton canadensis*, Billings.
*Metoptoma erato*, Billings.
*Metoptoma superba*, Billings.
*Bellerophon charon*, Billings.
*Bellerophon argo*, Billings.
*Bellerophon bilobatus*, Sowerby.
*Bucania bidorsata*, Emmons.
*Cyrtolites compressus*, Conrad.
*Pterotheca expansa*, Hall.
*Maclurea logani*, Salter.

### CEPHALOPODA.

*Orthoceras (Actinoceras) allumettense*, Billings.
*Orthoceras (Actinoceras) bigsbyi*, Stokes.
*Orthoceras bilineatum*, Hall.
*Orthoceras laqueatum*, Hall.

*Orthoceras anellum*, Conrad.
*Orthoceras strigatum*, Hall.
*Orthoceras arcuoliratum*, Hall.
*Orthoceras hastatum*, Billings.
*Orthoceras recticameratum*, Hall.
*Orthoceras tenerum*, Billings.
*Endoceras multitubulatum*, Hall.
*Oncoceras constrictum*, Hall.
*Cyrtoceras billingsi*, Salter.
*Cyrtoceras falx*, Billings.
*Cyrtoceras regulare*, Billings.
*Gonioceras anceps*, Hall.

### TRILOBITA.

*Dalmanites callicephalus*, Green.
*Cytheropsis siliqua*, Jones.
*Cytheropsis rugosa*, Jones.
*Leperditia canadensis*, Jones.

### B.

### FROM BONNECHÈRE RIVER, COUNTY OF RENFREW, ONTARIO. FOURTH CHUTE OF THE BONNECHÈRE RIVER, COLLECTED BY E. BILLINGS.

*Pachydictya acuta*, Hall.
*Obolellina canadensis*, Billings.
*Orthis (Hebertella) insculpta*, Hall.
*Strophomena incurvata*, Shepard.
*Cyrtodonta canadensis*, Billings.
*Bathyurus spiniger*, Hall.

These two series, A and B are to be seen in the Black River cases of the Geological Museum on Sussex street, Ottawa.

*Peter Redpath Museum Collections. McGill University, Montreal.*

### A.—PAQUETTE RAPIDS, OTTAWA RIVER.

*List of species of Organic remains from Paquette rapids, Ottawa river, exhibited in the cases of the Peter Redpath Museum of McGill University, Montreal.*

These were determined for the most part by the late Sir William Dawson and various officers of the Geological Survey of Canada. They include specimens from the "Dawson Collection" and were collected by Mr. R. J. B. Howard, B. A., and the writer in 1878 and 1880 respectively. They are all referred to the Black River division of the Trenton group, and although the most recent and more critical nomenclature is not employed in the generic as well as specific references, nevertheless, the species and fauna can easily be recognised.

The numbers are those noted on the specimens in the Peter Redpath Museum. The name of the collector, the precise locality and the date when the specimens were collected, whenever obtainable or indicated, have been added.

### PAQUETTE RAPIDS FOSSILS, OTTAWA RIVER.

*Stromatocerium rugosum*, Hall. Nos. 752 and 862. H. M. A. 1880.

*Receptaculites occidentalis*, Salter. No. 764, H. M. A. 1880.

*Calapœcia canadensis*, Billings, No. 757, Donor: Geological Survey.

*Columnaria alveolata.* (=*Columnaria halli*, Nicholson,) No. 1867. Dr. D. K. Cowley.

*Petraia cornicula*, Hall. No. 741.

*Petraia profunda*, (=*Streptelasma profundum*, Hall) No. 742. R. J. B. Howard, 1879.

*Orthis tricenaria*, Conrad, No. 709, R. J. B. Howard, Esq. 1879.

*Strophomena*, sp. (A slab of limestone with several specimens of *Strophomena incurvata*, Shepard, the *Streptorhynchus filitextusum*, of Hall, and authors generally). No. 968. Also *Murchisonia bellicincta* on the same slab.

*Bellerophon charon*, Billings. H. M. A. 1880.

*Helicotoma planulata*, Salter, H. M. A. 1880.

There is a specimen labelled *Helicotoma larvata*, which is evidently *H. planulata*, Salter, No. 694, R. J. B. Howard, Esq., 1879.

*Murchisonia gracilis*, Hall, No. 660, R. J. B. Howard, Esq., 1879.

(Another specimen, No. 667 is silicified and was collected by the same person, same date.)

*Murchisonia bicincta*, Hall. (=*Murchisonia milleri*, Hall); (=probably *Hormotoma bicincta*, Hall) No. 6, 62, Donor: Geological Survey.

*Murchisonia bellicincta*, Hall. No. 681, Two specimens: One silicified, the other not, the latter is a dolomitized cast of the interior of a specimen.

*Ctenodonta gibbosa*, Salter, H. M. A. 1880. *Ctenodonta nasuta*, Conrad. No. 690, J. Richardson,

*Ctenodonta nasuta*, Conrad, H. M. A. 1880

*Ctenodonta astartæformis*, Salter, H. M. A. 1880.

*Maclurea logani*, Salter. (a) No. 674, *Opercula*, No. 675. Examples of shells in a silicified condition. R. J. B. Howard, 1879, (b) Nos. 929, 930, 931, 932, These include several silicified shells and opercula of this interesting species, H. M. A. Sept. 1880.

? *Lituites undatus*, H. M. A. 1880.

*Orthoceras bigsbyi*, No. 654. Silicified example exhibiting portion of the mummuloidal siphuncle with fifteen annulations.

*Orthoceras*, sp., E. Billings.

### (B) JESSUP RAPIDS, OTTAWA RIVER.

From the above locality there are three species exhibited in the Museum cases of McGill University as follows:—

*Columnaria alveolata*, (=*Columnaria halli*, Nicholson,) No 892.

*Orthoceras pretiosa* (sic) No. 874. This orthoceratite appears to be an *Endoceras*, allied to *Endoceras proteiforme*, Hall, Donor: Geological Survey.

*Endoceras*; No. 813, Collector and date not given.

### (C) POINTE SÈCHE, FORT COULONGE.

*Stromatocerium rugosum*, Hall.

A silicified example of this species. Collector: J. Richardson.

### (D) FOURTH CHUTE OF THE BONNECHÈRE.

*Murchisonia gracilis*, Hall. A silicified specimen. Collector's name not indicated.

## THE PLEISTOCENE DEPOSITS.

### (A) THE MARINE SEDIMENTS. LEDA CLAY OR "GREENS CREEK FORMATION."

*Mallotus villosus*, Cuvier, The ordinary capelin of the lower St. Lawrence and Hudson Bay locality.—Flat rapids, Madawaska river, Renfrew county, O.

### (B) THE FRESH-WATER MARL DEPOSITS: LACUSTRINE.

*Anodonta fluviatilis.*

*Cyclas orbicularis.*

*Paludina decisa.*

*Physa heterostropha.*

*Planorbis campanulatus.*

# SELECTED LIST OF REPORTS
(SINCE 1885)
# OF SPECIAL ECONOMIC INTEREST

PUBLISHED BY

## THE MINES DEPARTMENT OF CANADA

(A.—*Published by the Geological Survey.*)

### MINERAL RESOURCES BULLETINS

818. Platinum.
851. Coal.
854. Asbestus.
857. Infusorial Earth.
858. Manganese.
859. Salt.
860. Zinc.
869. Mica.
872. Molybdenum and Tungsten.
877. Graphite
880. Peat.
881. Phosphates.
882. Copper
913. Mineral Pigments.
953. Barytes.

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745. Altitudes of Canada, by J. White. 1899. (40c.)

### BRITISH COLUMBIA.

212. The Rocky Mountains (between latitudes 49° and 51° 30'), by G. M. Dawson. 1885. (25c.).
235. Vancouver Island, by G. M. Dawson. 1886. (25c.).
236. The Rocky Mountains, Geological Structure, by R. G. McConnell. 1886. (20c.).
263. Cariboo mining district, by A. Bowman. 1887. (25c.).
272. Mineral Wealth, by G. M. Dawson.
294. West Kootenay district, by G. M. Dawson. 1888–89. (35c.).
573. Kamloops district, by G. M. Dawson. 1894. (35c.)
574. Finlay and Omineca Rivers, by R. G. McConnell. 1894. (15c.)
743. Atlin Lake mining div., by J. C. Gwillim. 1899. (10c.)
939. Rossland district, B.C., by R. W. Brock. (10c.)
940. Graham Island, B.C., by R. W. Ells, 1905. (10c.)
949. Cascade Coal Field, by D. B. Dowling. (10c.)

### YUKON AND MACKENZIE.

260. Yukon district, by G. M. Dawson. 1887. (30c.)
295. Yukon and Mackenzie Basins, by R. G. McConnell. 1889. (25c.)
687. Klondike gold fields (preliminary), by R. G. McConnell. 1900. (10c.)
884. Klondike gold fields, by R. G. McConnell. 1901. (25c.)
725. Great Bear Lake and region, by J. M. Bell. 1900. (10c.)
908. Windy Arm, Tagish Lake, by R. G. McConnell. 1906. (10c.)
942. Peel and Wind Rivers, by Chas. Camsell.
943. Upper Stewart River, by J. Keele }
979. Klondike gravels, by R. G. McConnell. } Bound together. (10c.)

### ALBERTA.

237. Central portion, by J. B. Tyrrell. 1886. (25c.)
324. Peace and Athabaska Rivers district, by R. G. McConnell. 1890-91. (25c.)
703. Yellowhead Pass route, by J. McEvoy. 1898. (15c.)

## SASKATCHEWAN.

213. Cypress Hills and Wood Mountain, by R. G. McConnell. 1885. (25c.)
601. Country between Athabaska Lake and Churchill River, by J. B. Tyrrell and D. B. Dowling. 1895. (15c.)
868. Souris River coal-field, by D. B. Dowling. 1902. (10c.)

## MANITOBA.

264. Duck and Riding Mountains, by J. B. Tyrrell. 1887–8. (10c.)
296. Glacial Lake Agassiz, by W. Upham. 1889. (25c.)
325. Northwestern portion, by J. B. Tyrrell, 1890-91. (25c.)
704. Lake Winnipeg (west shore), by D. B. Dowling. 1898.
705. " (east shore), by J. B. Tyrrell. 1898. (25c.) } Bound together.

## KEEWATIN AND FRANKLIN.

217. Hudson Bay and strait, by R. Bell. 1885. (15c.)
238. Hudson Bay, south of, by A. P. Low. 1886. (10c.)
239. Attawapiskat and Albany Rivers, by R. Bell. 1886. (15c.)
244. Northern portion of the Dominion, by G. M. Dawson. 1886. (20c.)
578. Berens River Basin, by D. B. Dowling. 1894. (15c.)
618. Northern Keewatin, by J. B. Tyrrell. 1896. (30c.).
787. Grass River region, by J. B. Tyrrell and D. B. Dowling. 1900. (25c.)
815. Ekwan River and Sutton Lakes, by D. B. Dowling. 1901. (15c.)
905. The Cruise of the *Neptune*, by A. P. Low. 1905. ($2.00).

## ONTARIO.

215. Lake of the Woods region, by A. C. Lawson. 1885. (25c.)
265. Rainy Lake region, by A. C. Lawson. 1887. (25c.)
266. Lake Superior, mines and mining, by E. D. Ingall. 1888. (25c.)
326. Sudbury mining district, by R. Bell. 1890-91. (20c.)
327. Hunter island, by W. H. Smith. 1890-91. (20c.)
332. Natural Gas and Petroleum, by H. P. H. Brumell. 1890-91. (25c.)
357. Victoria, Peterborough and Hastings counties, by F. D. Adams. 1892-93. (10c.)
627. On the French River sheet, by R. Bell. 1896. (10c.)
678. Seine River and Lake Shebandowan map-sheets, by W. McInnes. 1897. (20c.)
672. Nipissing and Timiskaming map-sheets, by A. E. Barlow. 1896. (In Vol. X. 80c.)
723. Iron deposits along Kingston and Pembroke Ry., by E. D. Ingall. 1900. (25c.)
739. Carleton, Russell and Prescott counties, by R. W. Ells. 1899 (25c.)(See No. 739 Quebec).
741. Ottawa and vicinity, by R. W. Ells. 1900. (15c.)
790. Perth sheet, by R. W. Ells. 1900. (10c.)
873. Sudbury Nickel and Copper deposits, by A. E. Barlow. (In Vol. XIV. 80c.)
977. Report on Pembroke sheet, Ont., by R. W. Ells. (10c.)
961. Reprint of No. 873.
962. " " 672.

## QUEBEC.

216. Mistassini expedition, by A. P. Low. 1884-5. (10c.)
240. Compton, Stanstead, Beauce, Richmond and Wolfe counties, by R. W. Ells. 1886. (25c.)
268. Mégantic, Beauce, Dorchester, Lévis Bellechasse and Montmagny counties, by R. W. Ells. 1887-8. (25c.)
297. Mineral resources, by R. W. Ells. 1889. (25c.)
328. Portneuf, Quebec and Montmagny counties, by A. P. Low. 1890-91. (15c.)
579. Eastern townships, Montreal sheet, by R. W. Ells and F. D. Adams. 1894. (15c).
670. Auriferous deposits, Southeastern portion, by R. Chalmers. 1895. (20c.)
591. Laurentian area north of the Island of Montreal, by F. D. Adams. 1895. (15c.)
672. Timiskaming map-sheet, by A. E. Barlow. 1896. (30c.) (In Vol. 10. 80c.)
707. Eastern townships, Three Rivers sheet, by R. W. Ells. 1898. (20c.)
739. Argenteuil, Wright, Labelle and Pontiac counties, by R. W. Ells. 1899. (25c.) (See No. 739, Ontario).
788. Nottaway basin, by R. Bell. 1900. (15c.)
863. Wells on Island of Montreal, by F. D. Adams. 1901. (30c.)
923. Chibougamou region, by A. P. Low. 1905. (10c.)

## UNGAVA AND LABRADOR.

217. Hudson Strait and Bay, by R. Bell. 1885. (15c.)
267. James Bay and east of Hudson Bay, by A. P. Low. 1887-88. (25c.)
584. Labrador Peninsula, by A. P. Low. 1895. (30c.)
657. Richmond Gulf to Ungava Bay, by A. P. Low. 1896. (10c.)
680. Hudson Strait (south shore) and Ungava Bay, by A. P. Low. 1898. (15c.)
713. Hudson Strait (north shore), by R. Bell. 1898. (20c.) } Bound together.
778. Hudson Bay, east coast, by A. P. Low. 1901. (25c.)
819. Nastapoka Islands, Hudson Bay, by A. P. Low. 1901. (10c.)

## NEW BRUNSWICK AND NOVA SCOTIA.

218. Western New Brunswick and Eastern Nova Scotia, by R. W. Ells. 1887 (20c.)
219. Carleton and Victoria cos., by L. W. Bailey. 1885. (20c.)
242 Victoria, Restigouche and Northumberland counties, N.B., by L. W. Bailey and W. McInnes. 1886. (10c.)
243. Guysborough, Antigonish, Pictou, Colchester and Halifax counties, N.S., by Hugh Fletcher and E. R. Faribault. 1886. (25c.)
269. Northern portion and adjacent areas, by L. W. Bailey and W. McInnes. 1887-88. (25c.)
330. Temiscouata and Rimouski counties, by L. W. Bailey and W. McInnes. 1890-91. (10c.)
331. Pictou and Colchester counties, N.S., by H. Fletcher. 1890-91. (20c.)
358. Southwestern Nova Scotia (Preliminary), by L. W. Bailey. 1892-93. (10c.)
628. Southwestern Nova Scotia, by L. W. Bailey. 1896. (20c.)
661. Mineral resources, N.B., by L. W. Bailey. 1897. (10c.)
New Brunswick geology, by R. W. Ells. 1887. (10c.)
797. Cambrian rocks of Cape Breton, by G. F. Matthew. 1900. (50c.)
799. Carboniferous system in N.B., by L. W. Bailey. 1900. (10c.)
803. Coal prospects in N.B., by H. S. Poole. 1900. (10c.) } Bound together.
871. Pictou coal field, by H. S. Poole. 1902. (10c.)

## IN PRESS.

970. Report on Niagara Falls, by Dr. J. W. Spencer.
968. Report to accompany map of the Moose Mountain area, Alta, by D. D. Cairnes.
974. Copper Bearing Rocks of Eastern Townships, by J. A. Dresser. (10c.)
980. Similkameen district, B.C., by Chas. Camsell. (10c.)
982. Conrad Mining district, Yukon, by D. D. Cairnes. (10c.)
988. Telkwa valley, B.C., by W. W. Leach. (10c.)

## IN PREPARATION.

Rossland district, B.C. (full report), by R. W. Brock.
Report on Prince Edward county, Brockville and Kingston map-sheet, by R. W. Ells.
Report on Cornwall sheet, by R. W. Ells.
Reports on Country between Lake Superior and Albany river, by W. J. Wilson and W. H. Collins.
Transcontinental location between Lake Nipigon and Sturgeon lake, Ont., by W. H. Collins.
Nanaimo and New Westminster districts, B.C., by O. E. LeRoy.

---

### (B.—*Published by the Mines Branch.*)

On the location and examination of magnetic ore deposits by magnetometric measurements. Eugene Haanel. 1904

Report of the Commission appointed to investigate the different electro-thermic processes for the smelting of iron ores and the making of steel in operation in Europe. (Only a few copies of this report are available.) By Eugene Haanel. 1904

Final report on the experiments made at Sault Ste. Marie, under Government auspices, in the smelting of Canadian iron ores by the electro-thermic process. Eugene Haanel. 1907.

Preliminary report on the Limestones and the Lime Industry of Manitoba. J. W. Wells. 1905.

Preliminary report on the raw materials, manufacture and uses of Hydraulic Cements in Manitoba. J. W. Wells. 1905.

Preliminary report on the industrial value of the Clays and Shales of Manitoba. (Only a few copies available.) J. W. Wells. 1905.

Mica, its occurrence, exploitation and uses. Fritz Cirkel. 1905. (Only a few copies available.)

Asbestus, its occurrence, exploitation and uses. Fritz Cirkel. 1905.

Report of the Commission appointed to investigate the Zinc Resources of British Columbia and the conditions affecting their exploitation. W. R. Ingalls. 1905.

Report on the present and prospective output of the Mines of the Silver-Cobalt ores of the Cobalt District. Eugene Haanel. 1907.

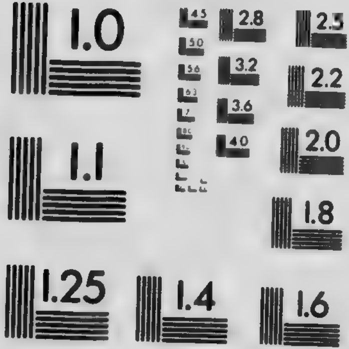
Report on the Mining Conditions of The Klondike, Yukon. Eugene Haanel. 1902.

## IN PRESS.

Monograph on Graphite. Fritz Cirkel.

# MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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## Explanation of Colours and Signs

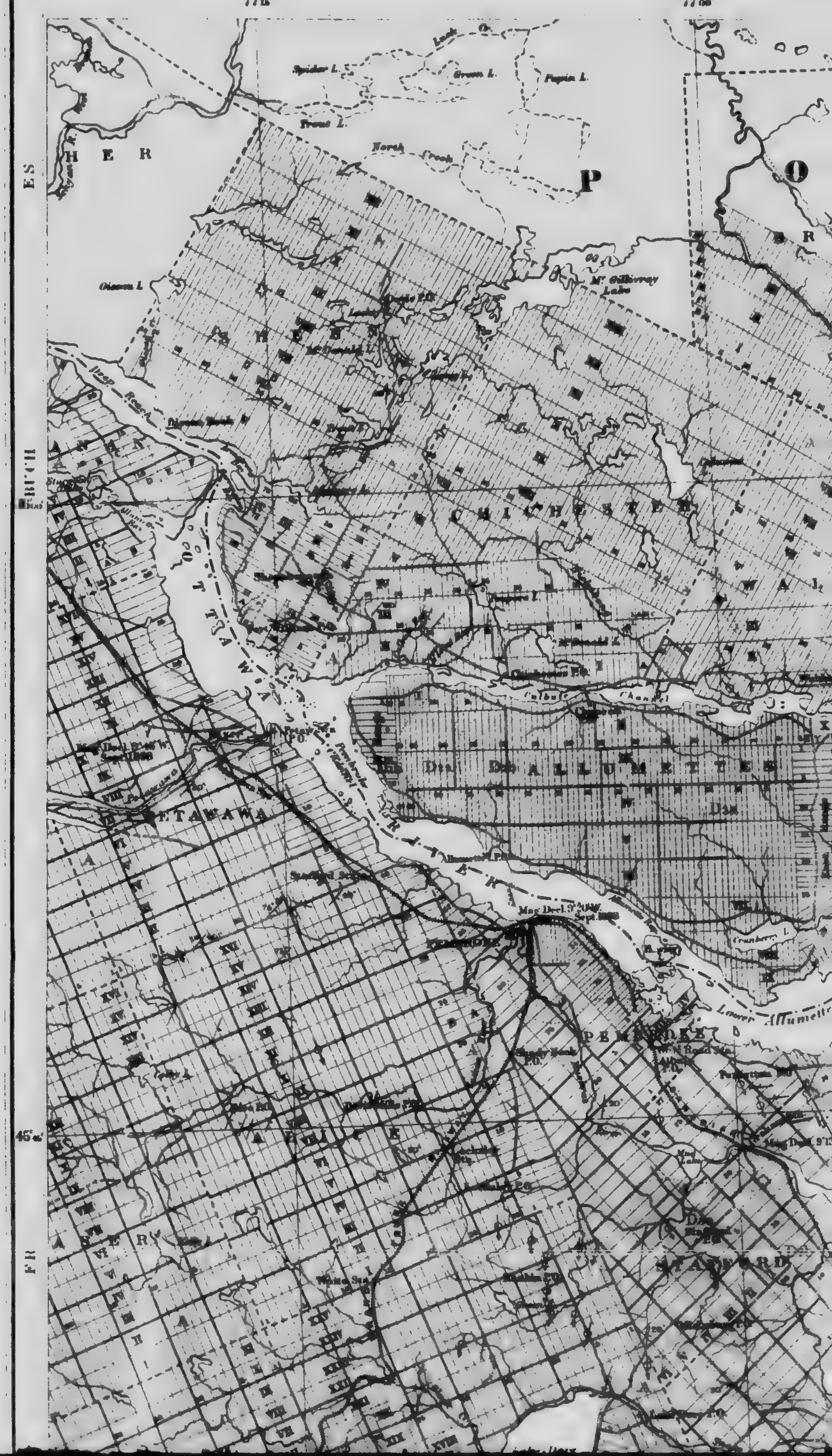
### Cambro Silurian

| | |
|---|---|
| D3b | *Trenton* |
| D3a | *Black River* |
| D2b | *Chazy limestone* |
| D2a | *Chazy shales* |
| D1b | *Calciferous* |
| D1a | *Potsdam sandstone* |

### Archæan

| | |
|---|---|
| A | *Amphibolites, schists etc* |
| A | *Crystalline limestone* |
| A | *Gneisses, etc* |
| Anor. | *Anorthosite* |
| | *Strike and dip.* |
| | *Faults* |
| | *Glacial striæ* |
| | *Gold* |
| | *Iron* |
| | *Argentiferous Galena and Zinc blende* |
| | *Mica* |
| | *Quarries* |
| | *Mines* |
| M | *Molybdenite* |
| | *Ochre* |
| | *Asbestos* |

*Jonas Sheet N°123*

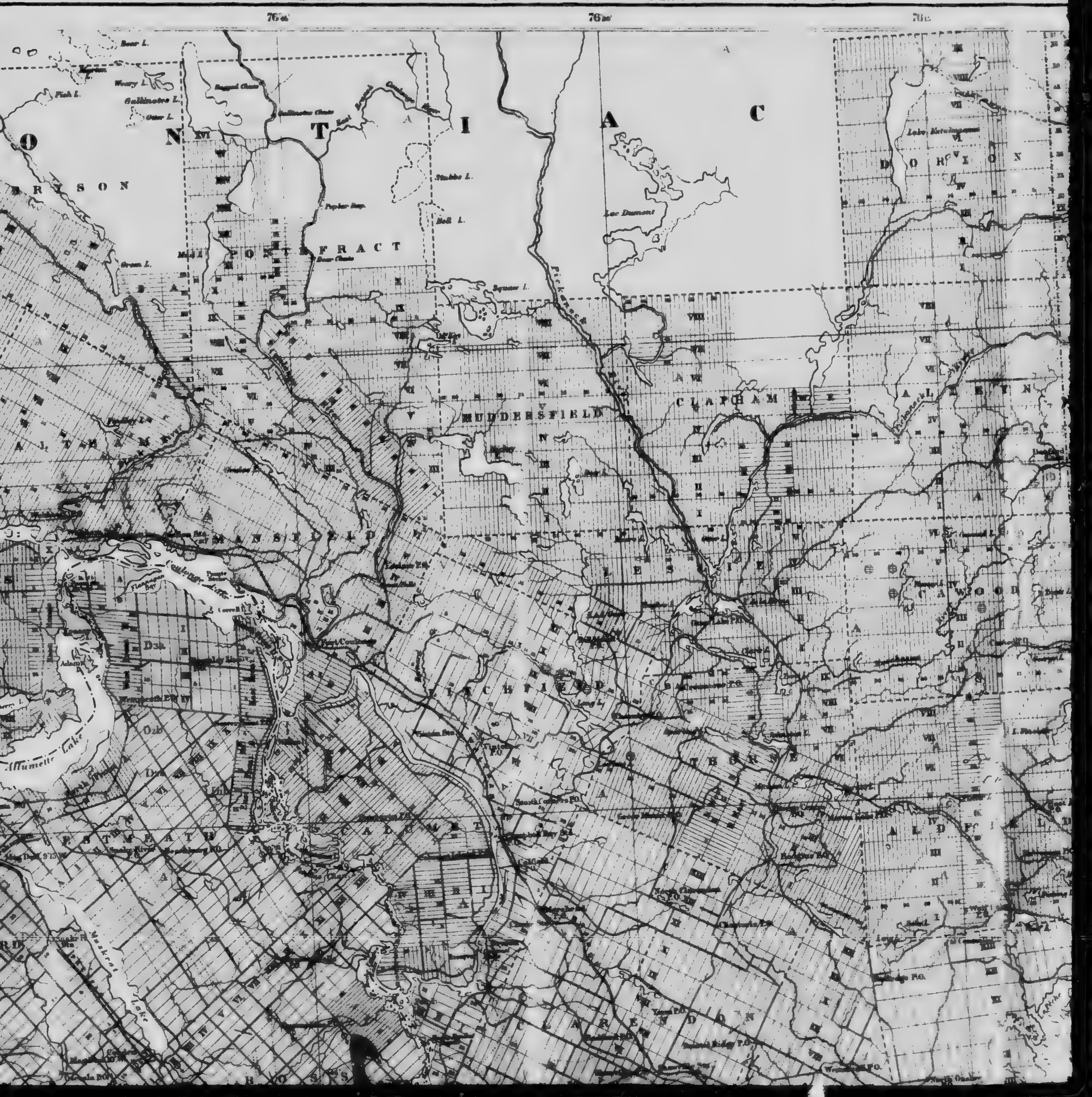


# Geological Survey of Canada

ROBERT BELL, D.Sc.(Cantab), M.D., LL.D., F.R.S., I.S.O., ACTING DIRECTOR.

1906.

*Issue Sheet No 183*



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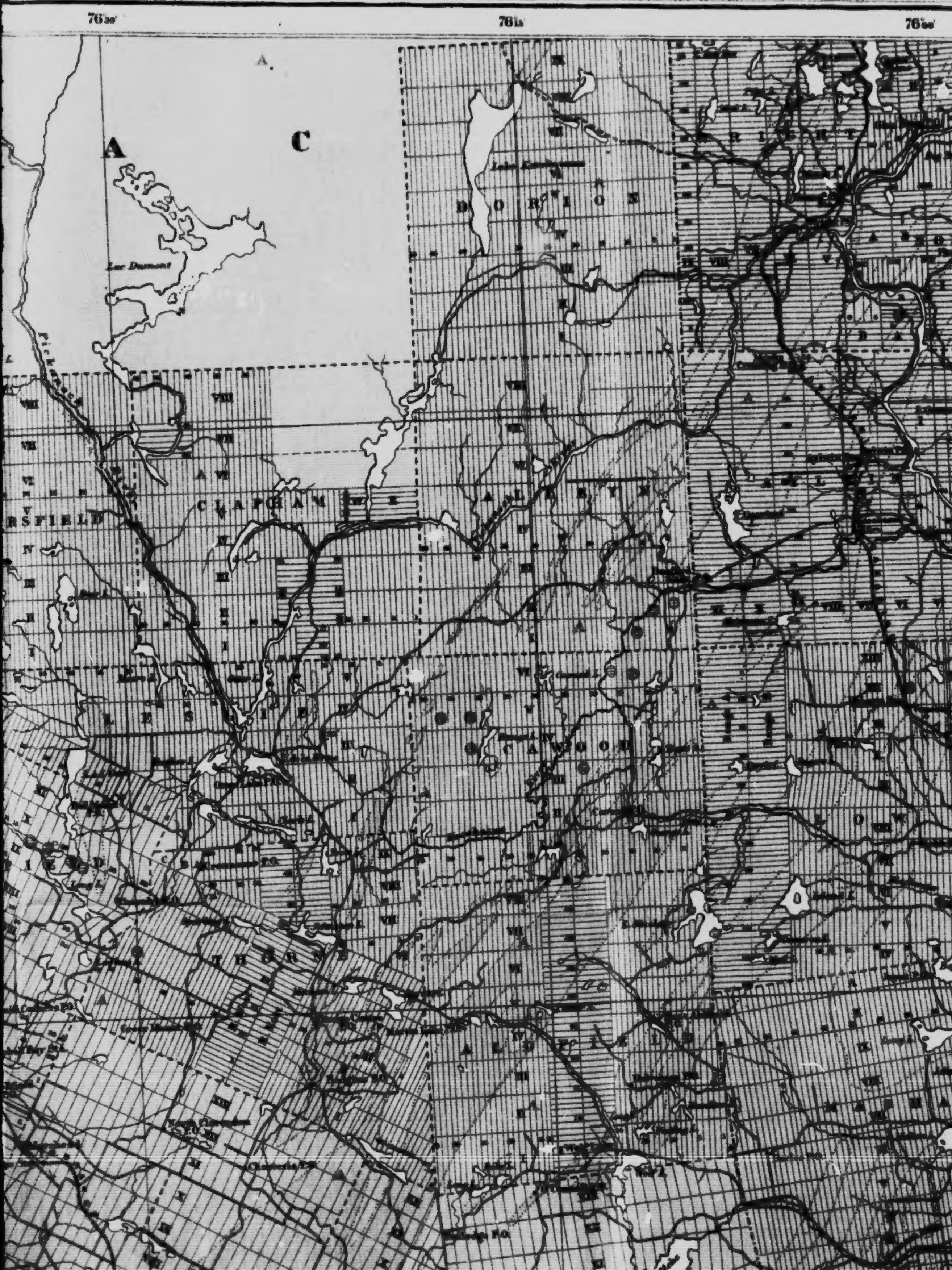
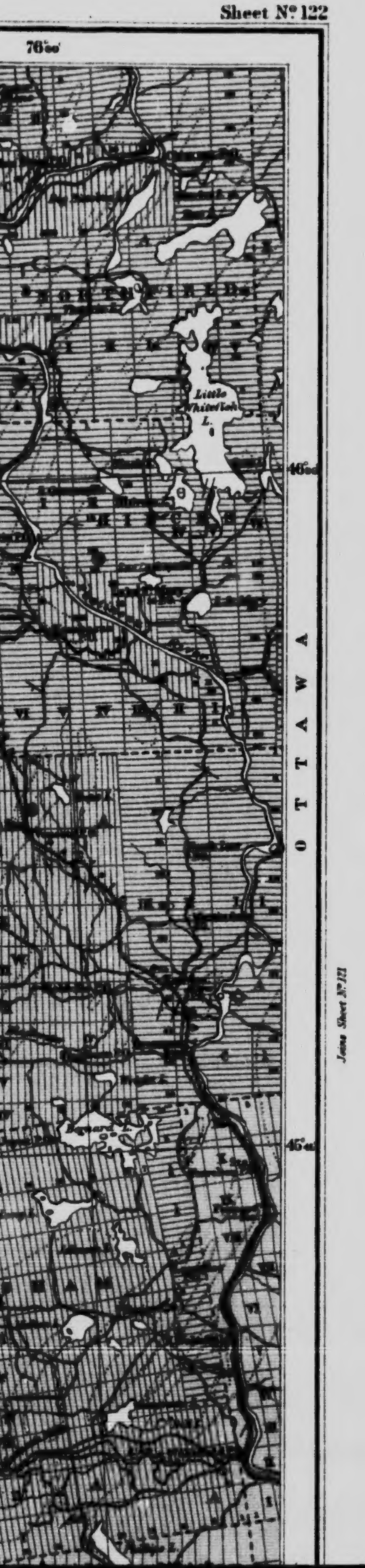




## GEOLOGICAL NOTES

### *Note 1.*

*The crystalline rocks of the district comprise both the so-called Fundamental gneiss and associated granite and the upper series of well-banded gneiss with quartzite and crystalline limestone; the latter are well seen in the eastern portion of the map-sheet while the older series have the largest development in the western half of the area. Here the limestone is generally absent and when it does occur, it is in the form of narrow overlying bands resting on well-bedded quartzose gneiss which sometimes, as on the upper Coulonge river, forms cliffs in which, at some distance, it presents a bedded aspect similar to that seen in some portions of the Potsdam sandstone. A similar bedded aspect of this upper gneiss is seen along the upper Nation river in the Grenville area.*

*The Fundamental gneiss is well seen in the western part of the map-sheet as along the Petawawa and north of Allumettes island. In this there is often a well-defined gneissic structure but the rock is frequently granitic and the regular series of banded gneisses is not seen. These rocks apparently represent the oldest known geological formation of the Ottawa district.*

*No economic minerals have as yet been recognized in this lower portion, while in that part of the gneiss associated with the quartzite and limestone, deposits of mica, apatite and graphite are numerous and of great value. These are frequently found in the area adjacent to the Gatineau river.*

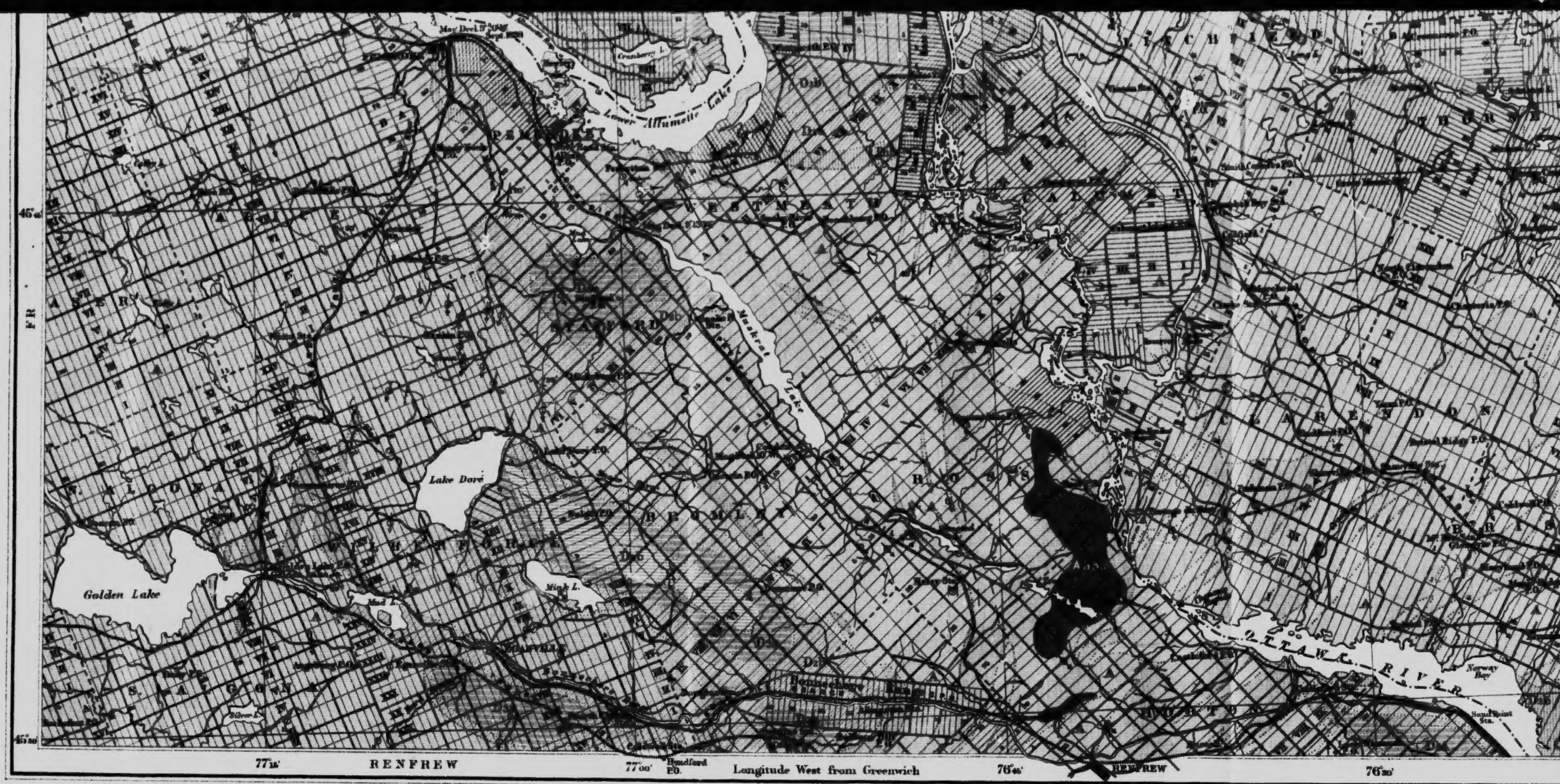
*The limestones occur generally in basins of greater or lesser extent and rep[illegible] the upper portion of the Archæan [illegible]. They usually rest upon well-bedded masses of white quartzite as seen near the Ottawa near Montebello. In the southern portion of the area as at the Bristol mines they are associated with hornblende-schists and kindred rocks which are more conspicuously seen in the area comprised in the map-sheet adjacent to the south (Perth sheet.)*

### *Note 2.*

*The Palæozoic rocks range from the Potsdam sandstone upward to the Trenton, both inclusive. Of the first named, a small outcrop is seen a short distance north of the village of Quio where the stone is quarried for local use. Here the formation passes up into and through the Calciferous into Chazy shales which occupy a considerable part of the village itself. Crossing the Ottawa river at this place the upward succession is continued unbroken through Chazy limestone and Black river formation into the lower part of the Trenton limestone which forms the plateau to the south.*

*Along the Ottawa river westward similar Palæozoic rocks are found, sometimes in isolated areas of small extent resting on the crystalline rocks but generally along the valleys of the rivers. The largest of these areas of sediments is seen on the Ottawa between the western end of Calumet island and the upper end of Allumettes island*

| | |
|---|---|
| Anor | *Anorthosite* |
| ⅄ | *Strike and dip.* |
| — | *Faults* |
| ⚲ | *Glacial striæ* |
| ✱ | *Gold.* |
| ♂ | *Iron.* |
| ♄ | *Argentiferous Galena and Zinc blende* |
| ● | *Mica.* |
| ☐ | *Quarries.* |
| ▨ | *Marl.* |
| ▣ | *Molybdenite.* |
| ♆ | *Ochre.* |
| ⊕ | *Asbestos* |



*C.O. Senécal, B.A.Sc., Geographer & Chief Draughtsman.*
*J. Keele, B.A.Sc., Draughtsman.*

*Magnetic Declination 9° to 11° W*

*Joins Sheet No. 119*

### *QUEBEC AND ONTARIO*

*Parts of Counties of Ottawa and Pontiac, Que.*
*Carleton and Renfrew, Ont.*
(Pembroke Sheet No. 122)

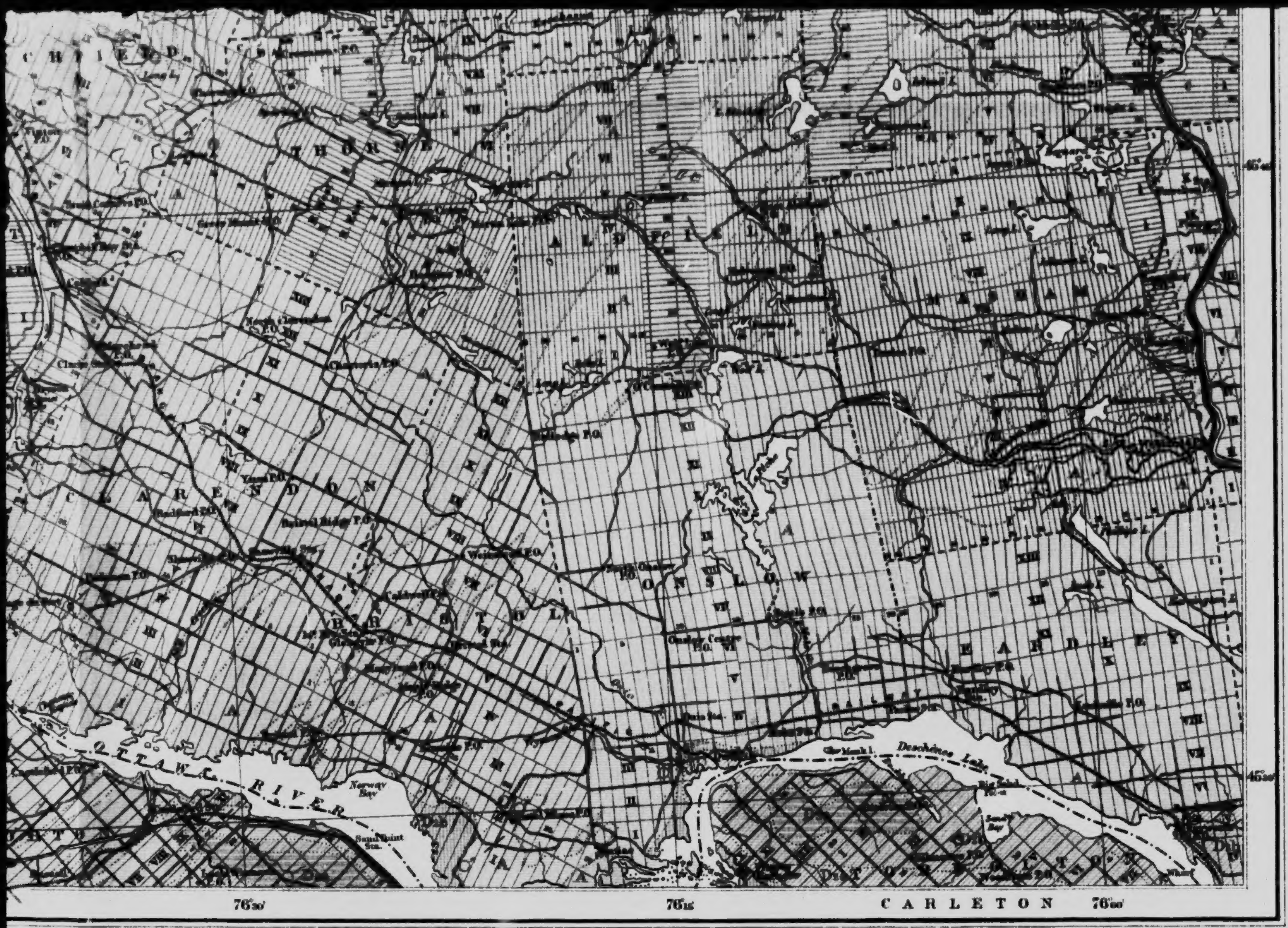
*Scale, 4 miles to 1 inch = $\frac{1}{253,440}$*

1 0 1 5 10 15 Miles

To accompany Report by
R.W. ELLS, LL.D., F.R.S.C.

## Sources of Information

*Surveys by the Geological Survey staff and official plans of surveys by the Crown Lands Department of Ontario.*



*of greater or lesser extent and represent the upper portion of the Archæan rocks. They usually rest upon well-bedded masses of white quartzite as seen near the Ottawa near Montebello. In the southern portion of the area as at the Bristol mines they are associated with hornblende-schists and kindred rocks which are more conspicuously seen in the area comprised in the map-sheet adjacent to the south (Perth sheet.)*

### *Note 2.*

*The Palæozoic rocks range from the Potsdam sandstone upward to the Trenton, both inclusive. Of the first named, a small outcrop is seen a short distance north of the village of Quio where the stone is quarried for local use. Here the formation passes up into and through the Calciferous into Chazy shales which occupy a considerable part of the village itself. Crossing the Ottawa river at this place the upward succession is continued unbroken through Chazy limestone and Black river formation into the lower part of the Trenton limestone which forms the plateau to the south.*

*Along the Ottawa river westward similar Palæozoic rocks are found, sometimes in isolated areas of small extent resting on the crystalline rocks but generally along the valleys of the rivers. The largest of these areas of sediments is seen on the Ottawa between the western end of Calumet island and the upper end of Allumettes island. In this area the lowest member of the series, the Potsdam, is not seen, nor is the upper or Trenton division. A similar outlier is exposed along the Bonnechere river to the south between Admaston and Golden lake, and this also forms a considerable area to the east of Lake Dore in which also the Trenton is found. Fossils are abundant in many localities and considerable collections have been made from time to time, the results of which are given in the appendix to the accompanying report.*

°119

*NTARIO*
*n and Pontiac, Que.*
*nfrew, Ont.*
et No 122

nch = $\frac{1}{253,440}$

10 15 Miles

Report by
.. F.R.S.C

No 660

## Sources of Information

*Surveys by the Geological Survey staff and official plans of surveys by the Crown Lands Department of Ontario.*